AUTOMOBILE NUMBER

SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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DISPATCHERS OF HIGHWAY TRAFFIC: NEW YORK'S TRAFFIC TOWERS IN ACTION

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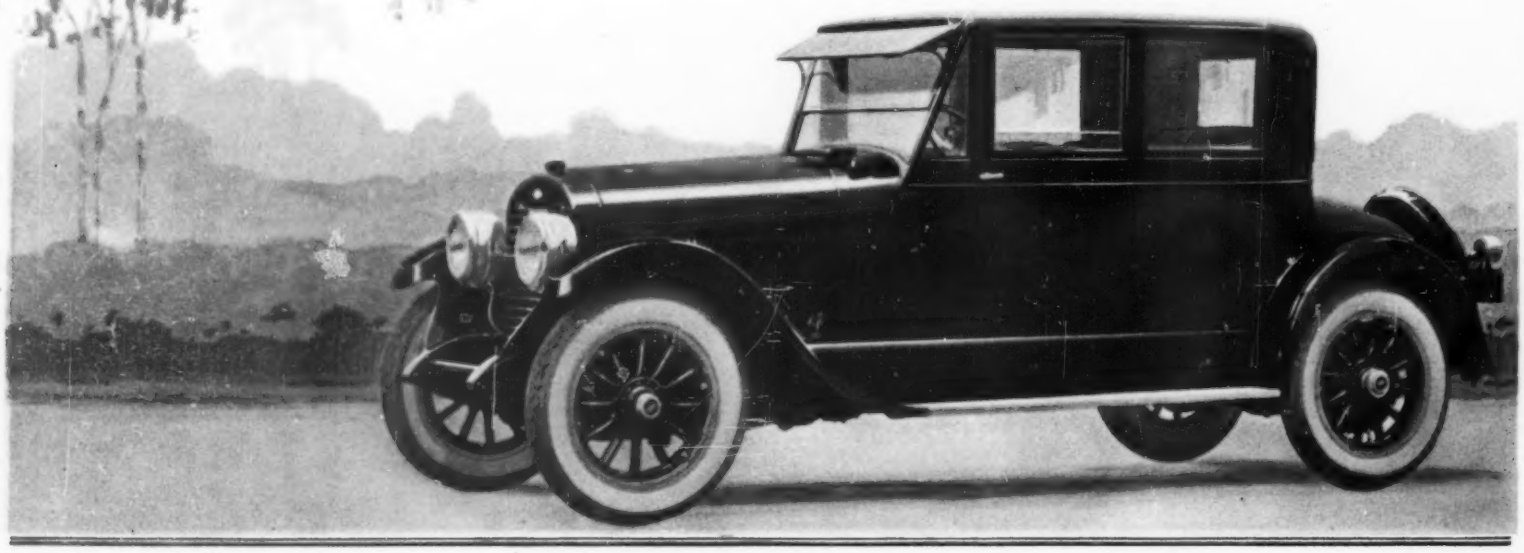

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With the Editors

THIS is the Automobile Number. At this time of the year our thoughts turn gently—or rather, are turned for us to the subject of automobiles. The advertisements and literature of the various automobile manufacturers proclaim the many virtues of their new offerings; the automobile shows tell of the greatness of the automotive industry; the new cars themselves excite the utmost curiosity at this time and until they become quite commonplace. So, all in all, the automobile is very much the subject of the hour at this time.

FOLLOWING a long-established SCIENTIFIC AMERICAN custom, we publish in this issue a chart of passenger car and commercial vehicle offerings for 1924. This chart will be found on pages 42, 43 and 44. Here, in condensed form, will be found the salient facts regarding the various types of passenger cars and commercial vehicles, so that the man with a definite amount to spend can "shop" to the best advantage.

WHEN there is a review of the trends and tendencies of the 1924 passenger cars, prepared by our Automotive Editor, Victor W. Pagé. And a mighty interesting review it is, for the 1924 offerings include an unusual number of fundamental innovations. Then there is a review of the economic position of motor transport, which must prove a revelation to many of us. Mr. Pagé has also prepared an article dealing with the relative advantages and possibilities of the air-cooled and water-cooled engines, which is a subject deserving far more consideration than it has received in the past. The question of lubrication and a discussion of the new balloon tires also figure in the automobile features of this issue. Attention is called to the ingenious pendulum device graphically described by our British staff artist, Mr. S. W. Clatworthy, on page . This odd automobile drive is the invention of a well-known Roumanian inventor residing in England, Mr. Constantinesco, whose remarkable system of wave-power transmission was described in these columns several years ago. This gentleman, it will be recalled, also devised the mechanism for timing a machine gun so that it will shoot through the sweep of an airplane propeller without touching the blades. His present invention is as efficient as it is strange, and it presents considerable food for thought. It is one of those subjects which must be worked out.

UNDER the title "Traffic and the Law," we discuss the peculiarities of our motor codes and customs in various states. It would be a waste of time and valuable space here to outline the serious situation now existing as regards highway traffic. What with the automobile manufacturers steadily increasing the output of cars, we are faced with a still more serious situation in the very near future. Not only in the matter of the standardization of state motor laws, but in the matter of highway facilities, grade crossings, ferry congestion, headlight glare, and other phases of present-day motoring, we have a traffic problem which demands immediate attention. The SCIENTIFIC AMERICAN therefore proposes, during the coming year, to devote special attention to the attempt to reduce the traffic problem to its fundamentals and to strike upon the best means of relief. The present article is the opening gun in this campaign.

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ELSEWHERE in this issue will be found the first article of a series entitled "The Story of Steel." A short while back Mr. J. Bernard Walker, the senior member of our editorial staff, visited the steel centers of the United States, starting with the great open-mine pits of the Missabe Range in Minnesota, then steaming down the lakes with the ore to the huge smelting works at Gary, and then on through with the pig iron and steel to the various fabricating shops that turn out all manner of rods, rails, pipes, wire, and so on. Back in 1903, Mr. Walker covered the same ground in a survey of the steel industry of that time, a special number devoted to the steel industry appearing in December of that year.

NEXT month, as usual, we shall have something in the psychic field. At the moment, we do not know what it will be. Mr. Bird has just had a most interesting four-day psychic adventure, which he will tell sooner or later. A series of formal sittings by our committee with another medium begin early in December, and presents the possibility that there may be enough for a story before the February number has to go to press. Some months ago we imposed upon the publishers of two epoch-making psychic books—Richet's "Thirty Years of Psychical Research" and Schrenck-Notzing's "Phenomena of Materialization"—to the extent of getting review copies from them. We have been waiting for an issue in which there was no other psychic story, intending to make a story out of these two volumes. One or another of these possibilities will supply the psychic material for February—and indeed, it will be seen that we are fortified against a complete calm in things psychic, of three months' duration.

FOR our February issue: A story on the romance of the lock, by Edward H. Smith, who has written so many interesting articles on the science of criminology; a museum in the open air, dealing with the wonderful life's work of Dr. Charles S. Sargent, who has the unique distinction of being the only director of an institution which has flourished under one management for over fifty years and is known today as the Arnold Arboretum, representing a collection of 5000 varieties of trees; the problems of the city planning engineer not only in laying out new cities, but in remodelling old ones; the energy of the atom and what are the chances of harnessing this energy, comes in for a popular discussion by Sir Oliver Lodge; the heat of the earth, always an interesting subject, is dealt with in an entertaining manner; what the Japanese earthquake did to the buildings of Tokio, is told in a graphic manner by photographs, as well as by excerpts from the reports of American engineers in charge of reconstruction work; the queer customs of the head hunters of the Fly River, New Guinea, are brought to us in pictures; the latest archaeological discoveries in the French cavern of Montespan, and the great paleontological surprise in the form of dinosaur's eggs uncovered in Mongolia; the remarkable American dirigible "Shenandoah" and how it is navigated—these are but a few of the many interesting features which will go to make the February issue more varied than ever. And the cover for that issue—the navigating room of the "Shenandoah" or ZR-1, drawn from life by our artist, Howard V. Brown.

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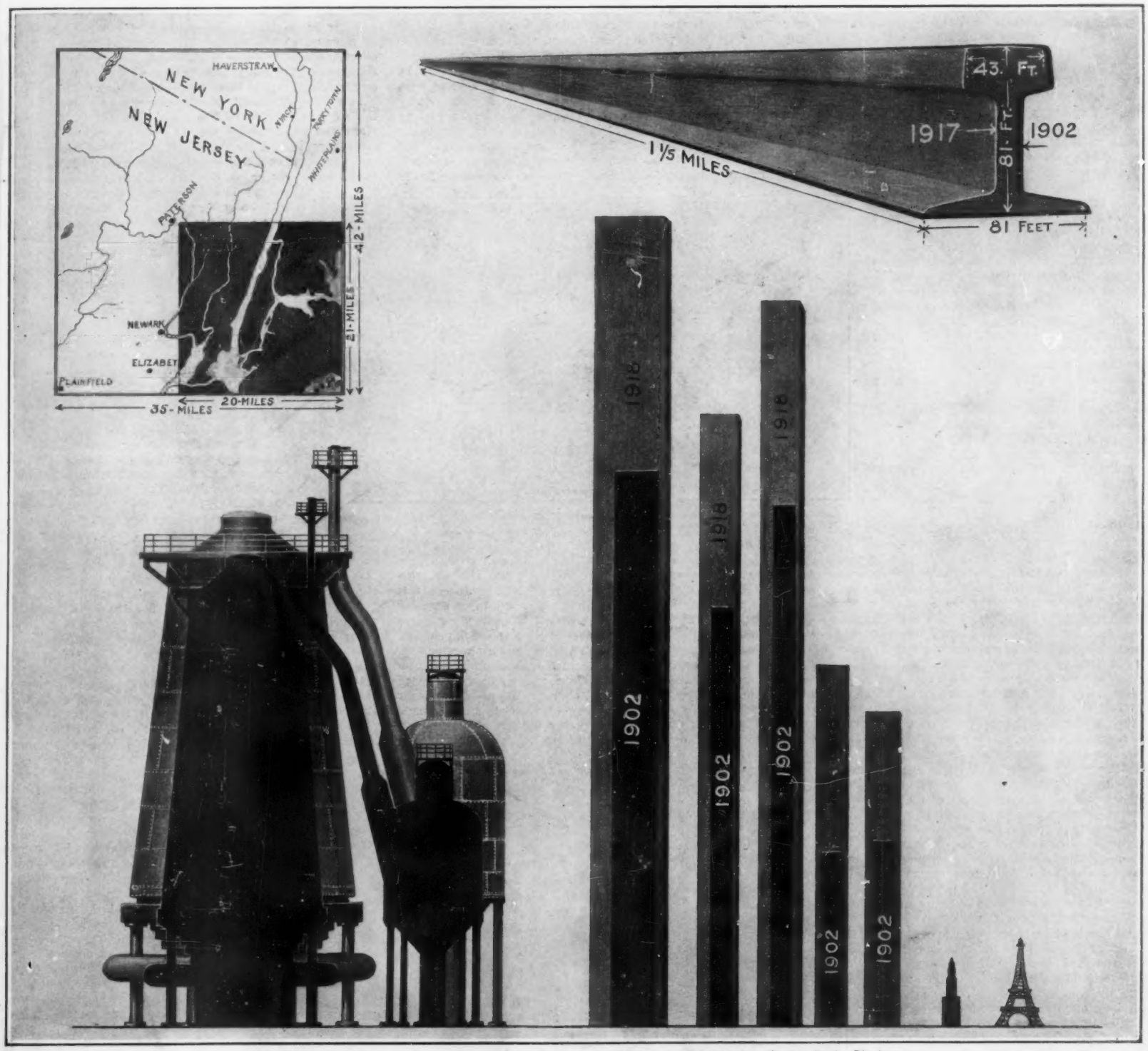
THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

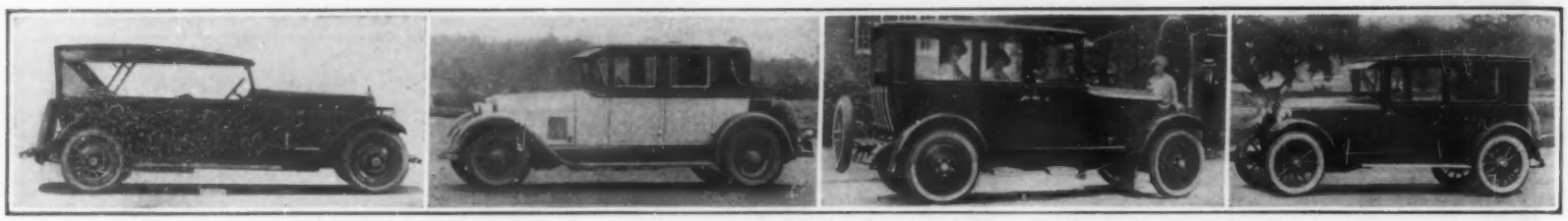
NEW YORK, JANUARY, 1924



Upper left: Sheets and plates. *Upper right:* Steel rails.

Growth of steel industry in United States from 1902 (dark shade) to banner year 1918 (light shade)

THE STORY OF STEEL—(See page 28)



Typical open and closed models, showing the simple but highly pleasing lines of the 1924 passenger car

Cars of 1924

Some of the More Interesting Features Revealed in the New Models

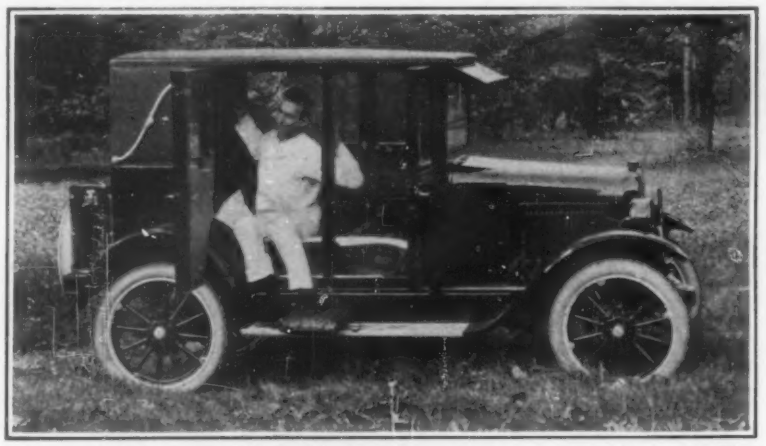
By Victor W. Pagé, M.S.A.E.

THE automobile as we know it today is not the result or conception of one brain, nor does any particular model represent only the ideas of the immediate engineering and sales organization of the builders. The new models have been designed by the sales and service departments fully as much as by the engineering staff; and, in the final analysis, engineers and designers are often subservient to these departments in organizations producing large quantities of cars which must be built to meet a price. In such a case, new engineering features cannot be looked for, because they are non-existent. Features which might improve economy of operation or efficiency of the mechanism cannot be used if production costs are increased by their use. Some automobile manufacturers have so standardized their designs by the use of stock parts in the assembly that no real engineering or inventive skill is necessary and designers are dispensed with altogether. Study of such cars cannot be expected to disclose new features, even though the value and practicality of the car itself cannot be questioned.

Automotive engineers do not believe, as some car producers seem to imagine, that there is no further room for improvement in existing designs. There are many purely mechanical problems involving suspension, engine balance or even carburetion and cooling that still cry out for solution. Much patient research and many chemical and physical experiments will be necessary before automobile design, even though it is well advanced, can be considered in its final stages. The modern trend on the part of manufacturers who really build cars, contrasted to those who only assemble them, is to bring out new and improved models every two or three years, incorporating new features that have real engineering merit. The education of designers and engineers is a progressive and continuous process; but the reaction upon the actual commercial practice of car design is necessarily intermittent and spasmodic.

The automobile of today is too complex in its mechanism to have been evolved through any flash of genius, but it has been built up step by step, interspersed by many a stumble and a fresh viewpoint before real progress was made. It is for this reason that the columns of the automotive press and the meeting rooms of our engineering societies have been enlivened by discussions of the advantages and disadvantages of features that may be new to the present-day motorist but which are nevertheless ancient history to the old-timer. I refer particularly to the lengthy and somewhat acrimonious discussion relative to four-wheel brakes, which are by no means new; I have distinct recollections of hearing many of the same arguments when the (Scotch) Argyl car engineers broached their use over thirteen years ago. Then again, although the four-versus-six-cylinder controversy has been settled by the selection of the simpler type by the majority of motorists who purchase our quantity-production cars, we have in its place consideration of the merits of the eight-in-line engine compared to the eight-cylinder V-type. It is fitting to remark in this connection that the motorist who is the most ardent protagonist of a four-cylinder car while he owns one is the first to graduate into the six-cylinder class when his purse permits him to take this step.

There is one thing that stands forth clearly in connection with power plant design, and that is the elimination of the twin-six engine; the well designed eight-cylinder types give every practical advantage to be derived from the greater number of cylinders, and with much less complication. There can be no controversy between the six and the eight, as here again history will repeat itself. It will again be a matter to be decided by shekels rather than engine diagrams. The writer has always been an ardent advocate of the six-cylinder engine for moderate cost cars and four-cylinder engines for low cost cars. At the same time, if his means permits, at any time in the future, the straight-eight will serve very nicely as motive power, because it is believed that this is the last word in motor car engines. The cost of repairs will be but little more than that of a six-cylinder engine, the balance and torque or power application will be much superior.

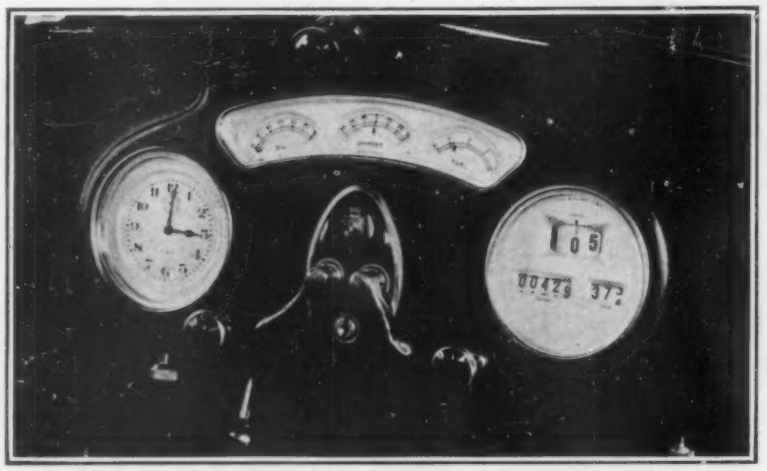


A new closed car in which cushions and rear seat are removable to provide luggage space or sleeping accommodations

In former years, there seemed a tacit understanding that cars below the $1,000 class would be powered with four-cylinder engines; and this condition obtained for some time. This year, however, several makers have announced six-cylinder cars for less than that figure, one prominent maker getting the jump on competition by announcing a small six phaeton at $750, while another is offering a six-cylinder closed car at $950. In either case, the builder of four-cylinder cars of this class has something to think about, and the motorist is the gainer. He can graduate to the superior type without waiting for the income-tax reduction.

For cheap cars and trucks, regardless of price, there is no type of engine that will prove superior to or supplant the four-cylinder when utmost service and minimum complication are the main factors to be considered: and, as racing engines have demonstrated, by increasing the cost of motor production and using a counterbalanced crankshaft, the four-cylinder may be made to run very smoothly. The increase in cost, however, might just as well be employed in building a six-cylinder engine as in refining the four-cylinder, because no four-cylinder can give the overlapping explosions or power impulses of the six-cylinder engine, where even a crankshaft of ordinary design without counterbalance weights can be used and smoother running obtained than in a four-cylinder. This explains why new low-priced six-cylinder cars are being offered for 1924.

Many new features of design are incorporated in the Packard straight eight. In the motor itself, an entirely new principle has been worked out, accomplishing, it is claimed, the complete elimination of the unbalanced forces usually found in all but six- and twelve-cylinder motors. Instead of placing, in effect, two four-cylinder motors end to end, as in some other straight eights, in the new Packard car a type of crankshaft is used that makes a radical departure from previous practice. Four crank-pin throws—two at each end of the shaft—are set at right angles from the center four throws. This makes possible an interlocking firing order that cancels both the primary and secondary forces, eliminating, it is asserted, vibration completely. Packard engineers say that the unleashed forces in an out-of-balance motor can run to more than a ton. The Packard straight eight has a 3⅜-inch bore and 5-inch stroke, with the reciprocating mass weighing 2.31 pounds per cylinder; the connecting rods are 10 inches long. In a four-cylinder motor with corresponding variables the engineers have worked out charts which would show that the unbalanced forces at 3000 revolutions a minute total 1475 pounds. In an eight-cylinder V-type motor of conventional design this same unleashed force runs up to 2080 pounds, while in a straight eight motor without the Packard type of crankshaft, and which has in effect two four-cylinder motors joined in tandem fashion, end to end, the unbalanced force reaches 2120 pounds.



The instrument board of the new year, as shown on one of the most popular eights

In the case of the Packard single-eight engine, the secondary forces are concentrated at the center of the engine and are completely neutralized or "cancelled out." Another way of viewing this proposition of perfect balance is to state that in any reciprocating engine which is composed of pistons, connecting rods and a crankshaft, in order to obtain freedom from vibration, it is necessary to have the reciprocating and rotating masses in balance at all times. If these conditions are fulfilled, the engine can be mounted on the frailest support and run at high speed without experiencing any difficulty due to exces-

sive vibration. Of all the engines discussed the single-six, twin-six and single-eight with the new-style crankshaft alone fill these requirements. The four-cylinder, eight-cylinder V-type, or twin-four, and usual eight-cylinder in line, or tandem four, engines all depend upon being rigidly bolted to the frame for absorption of their inherent vibrations. Naturally these vibrations are transmitted throughout the car and cause considerable annoyance to the passengers, especially at the so-called "critical speeds." It is claimed that the single-six, twin-six or new single-eight could be run at any car speed with the engine practically floating in space, there being no necessity for any of these engines to be bolted to the frame, other than to support their weight and take the driving reaction.

As the culmination of nine years' production of cars equipped with 90-degree, V-eight engines, the Cadillac Company announces a new type, the V-63, embodying the fundamental perfection of the V-type, 90-degree, eight-cylinder engine, inherently balanced, and with major parts improved. The new engine marks the practical accomplishment of an engineering feat long considered difficult of accomplishment by automotive engineers—the inherent balancing of the reciprocating parts of the V-type, eight-cylinder engine. With this inherent balance, the V-63 retains and combines all of the obvious and admitted advantages of the short, rigid crankshaft and crankcase, giving maximum rigidity in the engine structure and economy of chassis space, coupled with hitherto unknown smoothness of operation. The inherent balance of the reciprocating parts in this engine is the result of a new arrangement of the throws of the crankshaft. The four throws, or cranks, are in two planes at right angles to each other, instead of all in one plane, as in the previous V-eight practice. That is, when viewed from the end, if the crankpin at the forward end of the crankshaft be considered to correspond with the figure XII on the dial of a clock, the second, third and fourth crankpins would fall at three, nine and six o'clock, respectively.

Compensators, or counterweights, are used; and these, in combination with the new arrangement of crankshaft throws, cause the whole assembly—crankshaft, connecting rods and pistons—to operate with the smoothness of a balanced flywheel. With this rearrangement of the crankshaft throws, a new firing-order has been established. The same firing-interval is maintained, uniformly spaced, as on all Cadillac eight-cylinder engines. The firing-interval, it might be said in passing, is conditioned by the angle between the cylinder blocks; and the power impulses occur regularly every quarter-revolution of the crankshaft. With no other angle than 90 degrees will an eight-cylinder, V-type engine have a regular firing-interval and a uniform overlapping of impulses. The continuous flow of power characteristic of the Cadillac engine is due in a large measure to these factors.

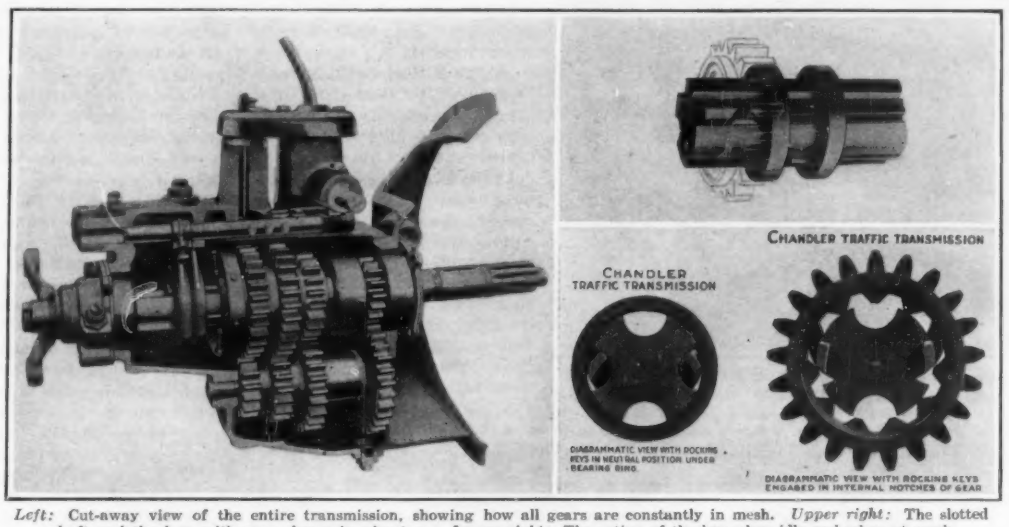
The discussion that obtains about four-wheel brakes reminds the writer of an equally heated controversy of several years ago relative to the advantages of four-wheel drive for trucks as opposed to utilizing only the rear wheels for traction. There was no question about the increased traction obtained by supplying power to all four wheels instead of only two, and here again the example of a locomotive, in which power was applied to six or eight driving wheels and superior traction thus obtained, was cited as an example of why trucks would be better if all wheels were driven. Very convincing arguments were advanced and four-wheel-drive trucks did all manner of stunts to show their superiority over those employing the more conventional system of drive. Yet there are no more makers of four-wheel-driven trucks now than there were then. This, of course, is not because the four-wheel drive was found to be impractical. In my opinion, the reason was that two-wheel-drive trucks were adequate in 95 per cent of the places where trucks could be used advantageously, and the greater mechanical complication of four-wheel drive militated against its general adoption, despite its proven superiority as a means of securing positive traction.

The situation is somewhat the same, in my mind, where four-wheel brakes are concerned. No one will question the fact that one can stop a car quicker by stopping rotation of all wheels than if only two wheels are braked. At the same time, no one can argue justly that four-wheel brakes do not involve added mechanical complication in an already complicated mechanism. Little fault can be found with a well designed two-wheel braking system if it is kept in adjustment. The reason two-wheel brakes have proven inadequate in some cases is because the design was not all that could be desired or because adjustments were neglected. Why anyone will expect the motorist or mechanic who now neglects a two-wheel braking system, both as regards adjustment and condition of brake linings, to be any more anxious about a system involving twice the work because it has twice as many parts, is beyond my reasoning powers. The writer does not question the advisability of using four-wheel brakes on expensive, heavy and fast cars; but from a number of years of service-station experience, he does question if they will work out under actual conditions of neglect and even abuse that cheap and light cars receive. The motorist who neglects to lubricate the bearing points of his chassis, fails to keep his tires properly inflated, and even forgets to put oil in the engine or water in the radiator, cannot by any stretch of the imagination be pictured giving four brakes the attention he now forgets to give to two.

The writer concedes the point that the brakes will function properly if they are maintained as they should be; and he agrees with the designer, who has spent many weary hours over the drafting board perfecting the four-wheel-brake system that works so well under test and in road demonstrations, that the system could not be expected to work well if neglected. One cannot put engineering brains into the head that abhors technical detail. As Grover Cleveland said, "It is a condition and not a theory that confronts us." If four-wheel brakes receive the attention their merits deserve they will give satisfaction, but two-wheel brakes work well under the same conditions. The fact that a Pullman car has twelve pairs of brake shoes is not a logical argument to use for the purpose of proving that an automobile should have four sets of braking elements, one in each wheel, in addition to a transmission brake and the ability to use the engine as a brake on occasions.

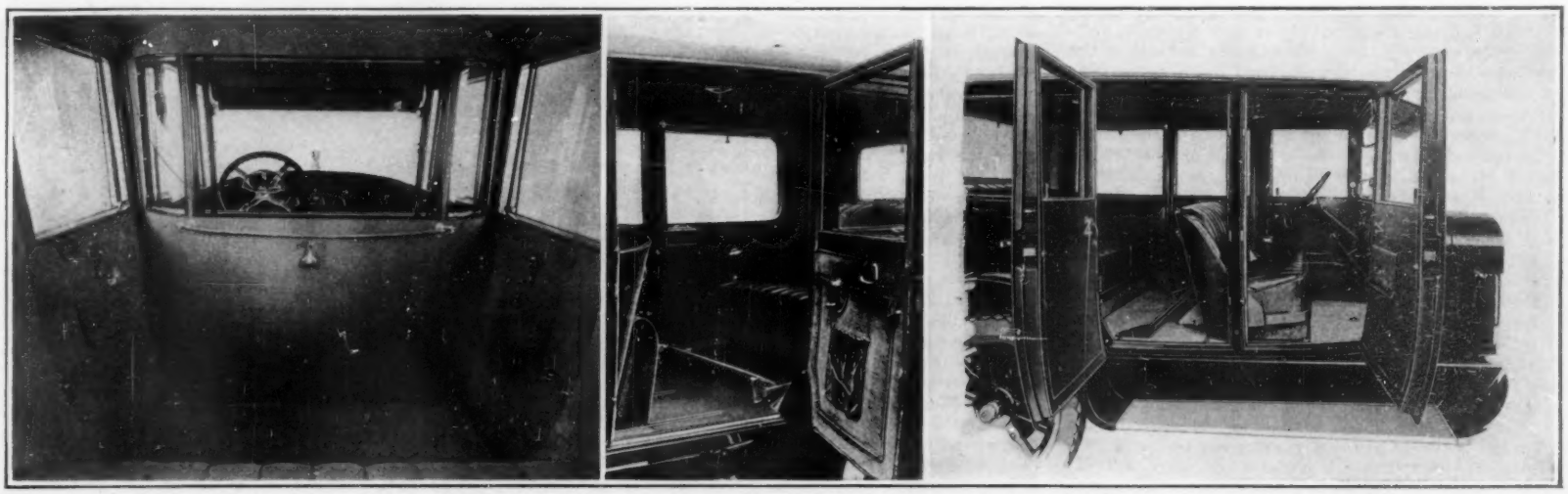
There is no question but that four-wheel brakes have caught the motoring public's fancy and they have been hailed with delight by municipal and highway authorities, who realize the many accidents resulting from unreliable braking systems. There is much to be said on both sides. Some makers are very enthusiastic about the four-wheel brakes, but qualify their enthusiasm by the cautionary advice to the purchaser that theirs is the only practical system; all the others are a snare and a delusion. Some more conservative car builders furnish them at extra cost if the purchaser desires; while other manufacturers, in order to be consistent in their advocacy of the innovation, equip all their cars with four-wheel brakes, even to light four-cylinder cars, where the two-wheel brakes have always proved to be adequate in the past.

Every maker advocating four-wheel brakes makes provision to prevent locking of the front wheels when the brakes are applied, on account of the danger if a rapidly moving car was stopped suddenly at a time when the wheels were swung around by the steering mechanism in rounding curves. Suppose some ignorant motorist or repairman alters this adjustment after the car leaves the factory, so that the brakes do lock?

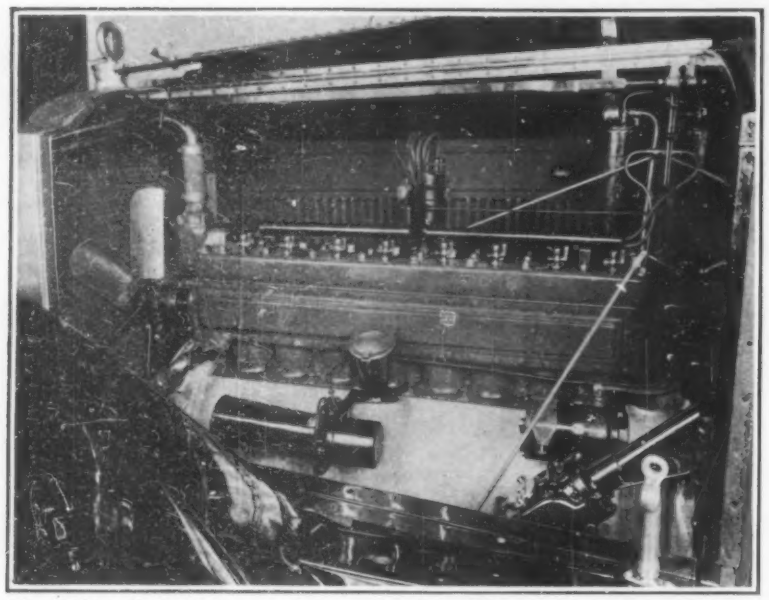

CHANDLER TRAFFIC TRANSMISSION
CHANDLER TRAFFIC TRANSMISSION
DIAGRAMMATIC VIEW WITH ROCKING KEYS IN NEUTRAL POSITION UNDER BEARING RING
DIAGRAMMATIC VIEW WITH ROCKING KEYS ENGAGED IN INTERNAL NOTCHES OF GEAR

Left: Cut-away view of the entire transmission, showing how all gears are constantly in mesh. *Upper right:* The slotted shaft and the key, with gear shown in phantom. *Lower right:* The action of the key when idle and when at work

Details of the new "traffic" transmission, which shifts with the familiar motions, but without any meshing of moving gears



Typical interiors of some of the fine cars of the new year, indicating the efforts being made toward still greater comfort and convenience



The eight-cylinder-in-line engine is not quite so long and lean in appearance as its name might indicate

Under these conditions, the advisability of using the brakes on the front wheels is justly open to question. Suppose the mechanism is so designed that it is impossible to lock the front wheels and only the rear wheels can be locked by the brakes? The bulk of the work is then done by the usual form of rear wheel brake; the others on the front are supplied only as a point of sales talk. As long as the ability to steer a car depends on the rolling motion of the front wheels, stopping this motion absolutely must inevitably make the car difficult to control.

Unusually heavy eight-throw crankshaft for straight eight

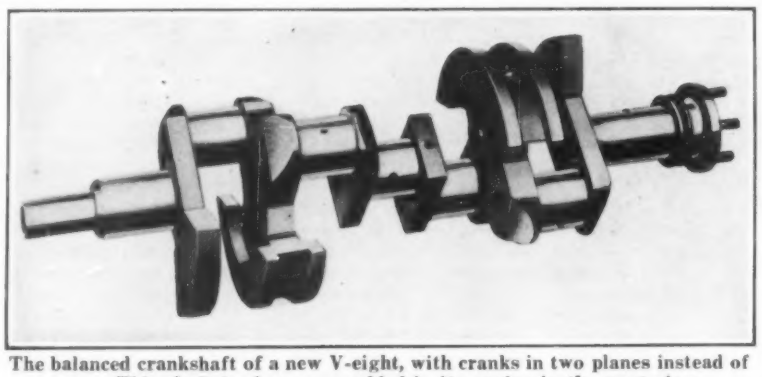
The problems involved in four-wheel-brake designs are manifold—although not quite so manifest—to the layman. The mere adding of another pair of brakes to the front wheels does not constitute a workable four-wheel-brake system. Had that been true, the first automobile ever made would probably have had brakes on all four wheels, for it is a matter of common knowledge that railway cars, for example, have brakes on all wheels. In an automobile we have many problems that do not arise in the building of any other vehicle, and these are due to the facility and ease with which it must be steered over any kind of road surface. For example: one would say that if the strain on the wheels were equalized so that the pressure between the shoe and the drum were precisely the same on each, a perfect four-wheel-brake should result.

Not at all! It is not so simple as that. In the first place, the braking effect must not be precisely the same on front as on rear wheels. The car must always have "steerage-way," which is to say the front wheels must continue to "roll"—never lock—under any circumstances. Neither is it desirable, of course, that the rear wheels lock. But no brakes have ever yet been made that a driver could not, under certain circumstances, lock, if he applied them quickly enough and with sufficient force. To render impossible the locking of the front wheels the strain between front and rear must be differentiated.

One of the most ardent protagonists of four-wheel braking systems operated by mechanical means is the Rickenbacker Company, who were among the first to announce the use of this equipment. In the Rickenbacker system this is accomplished by different degrees of leverage exerted from the foot lever to front and rear. Of course, the left wheels, both front and rear, must be equalized with regard to the right so as to take care of the difference in traction, under different conditions. This has always been done in the Rickenbacker with the most approved type of equalizer—the differential gear type.

Another differential equalizer now accomplishes the same purpose for the front wheels, and it is interesting to note the neat way in which this has been worked out. The differential mechanism is contained in the hub of the brake pedal itself, making one of the neatest installations the writer has yet seen. But they still had another, and more difficult problem, one which few European engineers have so far succeeded in solving. Of course, four-wheel brakes would be of little use if they did not operate just as well when turning, for in emergencies the quick-thinking driver uses his steering wheel as well as his brakes to avoid collision. Obviously, both must work perfectly and, above all, the brakes must not interfere with the steering. As an extra precaution against the possibility of locking the front wheels when turning, the brakes are so designed that as the wheels assume the turning angle they practically let go. In driving, this actually gives the driver better control of his car.

Brakes are all of the internal, expanding type, and, of course, the shoes are in two equal halves, or segments. The fabric surface of one segment will frequently wear more than that of its twin. This must be constantly and automatically compensated for. In the Rickenbacker car is a diamond-shaped shifting block which automatically accommodates itself to the difference in thickness of the brake lining, and exerts precisely the same pressure on opposite sides of the drum. Another little point, but a very important one: this automatic equalizing block, as well as the cam itself, is freely lubricated from the drip oil which comes down from the steering spindle, all of which are enclosed, so that only one oiling point is necessary to provide all these parts with constant lubrication. The front brake-shafts, on the outer end of which is the cam above described, are neatly concealed in housings integral with the front axle forging, and from the point where it leaves the axle to the point where it enters the wheel, it is encased in a water- and dust-proof boot, which is packed with grease. This integral housing also serves to reinforce the axle at the point where the extra torque stress of the front brakes exerts greatest effort.



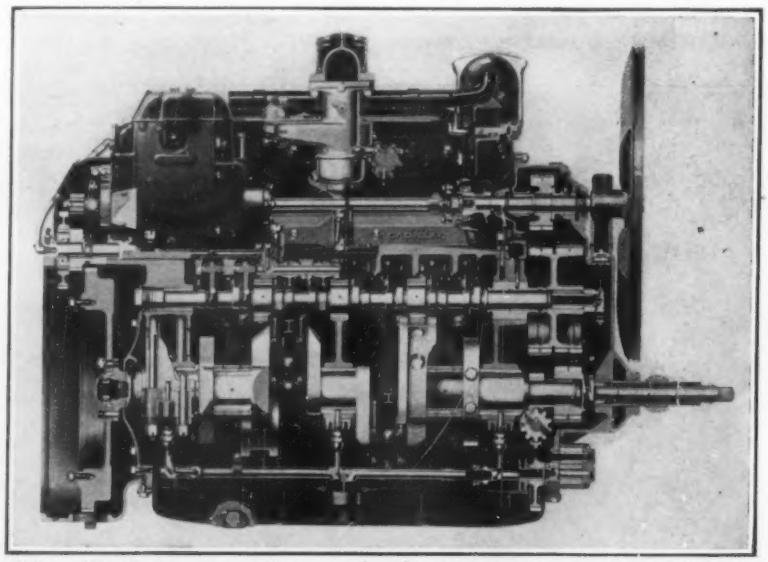
The balanced crankshaft of a new V-eight, with cranks in two planes instead of one. This shaft is shown assembled in its engine in the next view

Inasmuch as the drum must be free to revolve, of course there is a slight clearance between the outer edge of the brake anchor-disc and the revolving drum into which water could enter, if driving through a deep puddle or stream, although centrifugal force of the revolving drum makes this impossible under ordinary conditions. To provide against such unusual happening, holes have been drilled around the drum to permit any moisture to leak out. In fact, it would be thrown out by centrifugal force. These holes serve another valuable purpose. They are counter-sunk on the inside, so there are no rough edges to catch the friction which constitutes the brake lining, and they permit the air to escape when brakes are applied, so that the contact between the shoe and the drum is uniform and positive, whereas in the ordinary brake air pockets are liable to form and prevent efficient braking.

Adjustments on Rickenbacker four-wheel brakes have been developed to the point where it is claimed to be actually easier to adjust the four—and it can be done in less time—than the ordinary type can be adjusted on the two rear wheels. A plain monkey wrench is the only tool necessary, and a one-sixth turn of one adjusting nut on each brake. One person can do it and without soiling his hands or sleeve. If "one notch" on each is not sufficient, another notch will invariably compensate for any ordinary degree of wear since the last adjustment. The illustration shows the device by which this is accomplished.

The brake-shoe anchorage consists of a split sleeve, the inner surfaces of which each have one variable-depth slot. Wedges fit into these slots. As the wedges are drawn in by the turning of the adjusting nut, the split sleeve expands against the brake shoes, forcing them apart, thereby achieving the desired result of adjustment for wear. Notches are milled in the threaded section of the adjustment nut, and a steel ball, held in place by a spring, snaps into each slot as the nut is turned. As there are six of these slots, the ball will snap into place six times in one full revolution. The "feel" of this operation renders it ridiculously simple for anyone to adjust these brakes. Contrary to usual practice, the pull rods are never touched except when assembling the brake at the factory or when a new lining is being installed in the service station. Then the expanding "wedge" is backed all the way off and the rods adjusted to meet the new condition, after which the only adjustment necessary is that above described.

Rickenbacker engineers insist that the life of brake linings is increased many fold when the braking service is distributed over four; that the car will run fully ten times as many miles between adjustments; that tires wear longer; that strain on brakes and every other part of the car is less, because of the distribution of these stresses over two axles instead of one and over four springs and four wheels instead of two. While to the layman it would appear that these engineers insist that vastly greater results are achieved than would appear on the surface, their contentions are reasonable because

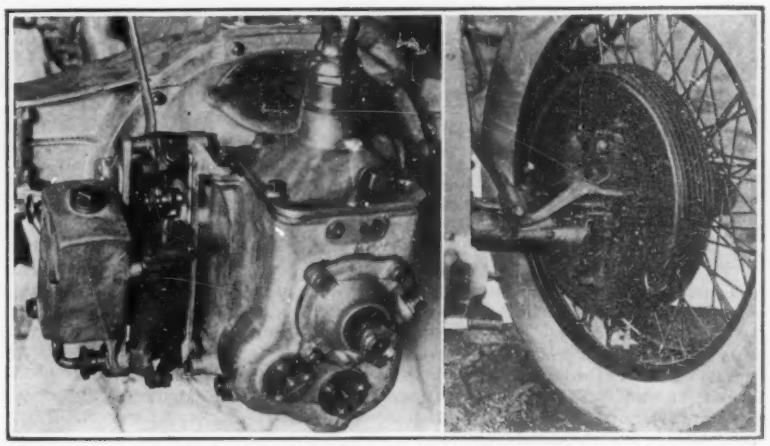


Side sectional view of new V-type eight, showing new compensated crankshaft, single camshaft with 16 cams and other new features

of the fact that there is less pressure per square inch of braking surface; less friction per square inch; therefore less heat generated; and the heat, always remaining at a much lower degree, radiates much faster. Less adjustment range is needed with this type of brakes, although in the Rickenbacker design more range is provided.

The life of the brakes, as well as their efficiency, is very greatly enhanced by the fact that the drums are accurately machined, which distributes the friction evenly over the entire surface of the linings and drums. By the method of anchoring and adjusting, the shoes are always concentric with the drums, so that the wear is absolutely uniform. In fact, the driver could wear his linings wafer thin and still they would operate as well as when new. The average brake shoe wears like a shoe on one's foot—in one or two places—whereas the Rickenbacker shoe cannot but wear evenly all around. Another interesting claim is that, while theoretically the same amount of foot pressure should be necessary to accomplish the same result with four wheel brakes as with two, experience proves that it requires considerably less than half as much. Also, that while, theoretically again, a car of given weight should stop within half the distance, it really stops in less than half, if the driver so desires. In a word, less than half the pressure of the foot stops the car in the same distance as with two-wheel brakes, while the same exertion stops it in less than half the distance.

All engineers who favor four-wheel brakes do not agree on the details of construction and application any more than they do on other points of automobile design. The Buick cars are provided with external constricting band brakes, but most cars employ internal expanding bands or cam-separated shoe brakes. In the Duesenberg car, which embodies a number of interesting engineering features, including an excellent straight-eight engine design, the four-wheel brakes are not an innovation, inasmuch as they have been provided on stock models for some time. In this car, the internal brakes are actuated hydraulically, this method also providing for compensation or equalization without mechanical linkage. A master cylinder is mounted on the transmission case, the brake pedal being attached to a piston rod which forces oil out of the cylinder through pipes running to brake-operating cylinders at the wheels. A reservoir mounted adjacent to the brake cylinder insures that it will always be filled with liquid.

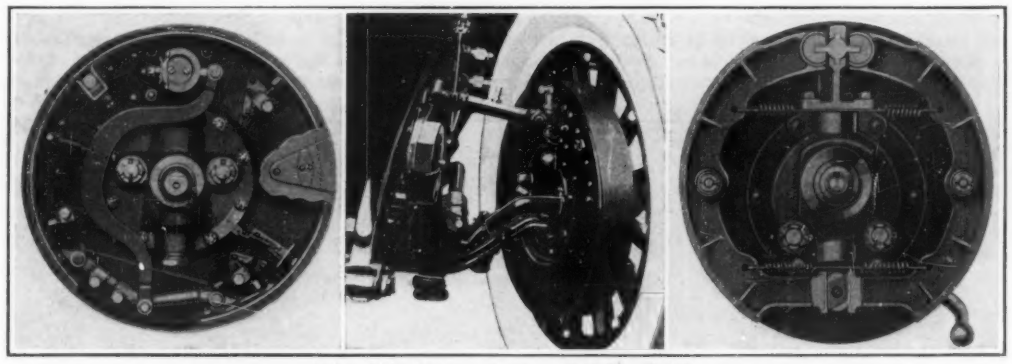


Note tubular front axle, hydraulic brake-line connection, complete enclosure of brakes, double support for steering arm, etc. At the left is shown the master cylinder for operation of the brakes, mounted on transmission case, with brake-liquid reservoir mounted outside

Typical hydraulic front-wheel brake, showing wheel installation and reservoir

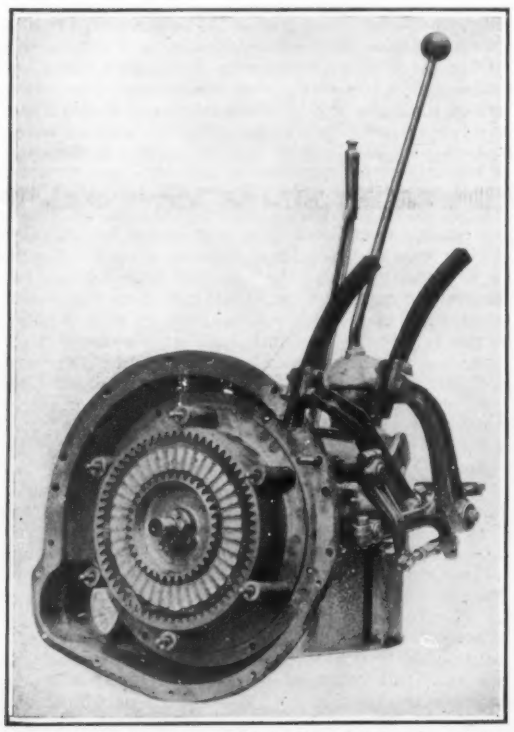
Several other makers have announced hydraulically operated brakes for the coming season, but most brakes are operated by the usual mechanical linkage.

One of the most improved and distinct mechanical features of the year is the multiple-disc, self-adjusting clutch recently announced by the Cole. For some time Cole engineers have concentrated their efforts on the development of a clutch that would give ease in the shifting of gears as well as silence, which is considered one of the outstanding attributes of a finer motor car. Disc clutches have been used in motor car power plants for years, and essentially they have not changed in their construction or operating efficiency since their inception. The new clutch is an eleven-plate multiple disc and not a single-plate type. Among the features that make it stand out mechanically is, first, the elimination of any tendency to clatter, grab or distort. This is done by the use of special steel stock and special milling process in making the plates. And in addition to this, a second point of novelty is the construction of the fabric friction plates. Instead of building upon a plate of solid fabric composition or riveting the fabric on to the face of the steel plate, a corded fabric has been woven into the plate itself. This special combination fabric-and-steel plate, because of its integral construction, absolutely resists the deteriorating forces that have in the past prevented the highest efficiency in clutch operation. This new construction will eliminate the troubles of fabric ripped off the plate through strain or the solid fabric plates broken under the strain and pull of the plates. The feature that makes the clutch self-adjusting comes from the six coil springs that keep the plates snugly together at all times. As the fabric wears and space is created between the plates, these springs take up the play, keeping the fabric pressed tightly against the steel plates, which feature, however, seems to be shared by almost all spring-controlled friction clutches.



Left: Rickenbacker. *Center and right:* Cadillac

Three views of the front-wheel members of two mechanically operated four-wheel-braking systems



A new self-adjusting multiple-disc clutch using plates with woven corded fabric

On the new Chandler cars one finds a gear-set construction of the constant mesh type that is reminiscent of the gear box formerly used on the Berkshire cars, a New England product that only pioneers in the industry will recall. The principle is a practical one and, of course, is a great improvement over the earlier form of sliding key engagement. The new construction is clearly outlined in the accompanying illustrations. The big advantage is that speed changes can be made in either direction and with equal facility and at any speed of car and engine; and the method of operation is such that the motorist does not have to learn to manipulate it—the lever shift is the same as with any sliding gear-set operating on the selective principle.

The illustration shows the Chandler transmission cut away to reveal the shafts and gears. Note the solidity of the layout and the sturdiness of the gears. Note also that in general it follows the layout of the ordinary transmission. In the old fashioned gear-set, gears were changed by sliding the gear wheels along the driven shaft, which was slotted so that the gears must always revolve with the shaft. In the new transmission the shaft is free to revolve within the gears, which, however, do not slide back and forth. They remain in mesh with their corresponding gears just as the constant-mesh gear of the sliding-gear transmission always remained in mesh, turning the countershaft. The sliding keys are visible to the left of the gears, and the forks that slide them. When it is desired to engage any particular gear, the shifting lever is moved to the desired position. This causes the heavy keys shown in the smaller views at the right to slide in the deep grooves in the shaft. When all gears are in neutral, the heavy lugs on the ends of the keys lie wholly within the bearing rings upon which the gear runs when sliding. Two of these rings support each gear. When the keys are shifted, they move clear of these rings, and when clear rock the heavy lugs out into the deep notches cut in the internal circumference of the gears. The keys are bound to rock fully into place because the action of the gears themselves turns the keys into their proper position. Note that the gear is locked to the shaft so that it cannot revolve in either direction, thus eliminating backlash. When the keys are engaged, they cannot rock farther, being restrained by the heavy bearing rings.

Another innovation that has received practical application on the Apperson cars is a mechanical gear-shift in which all hand operation of a gear-shifting lever is eliminated, except for a small pre-selection change-speed lever on top of the wheel, which can be operated by the pressure of the finger or thumb. The actual gear-shifting unit is bolted to the transmission below the floor and is out of sight. The operation is simplicity itself; the selector lever is moved to the desired position and, pushing out the clutch in the usual manner, shifts the gears. This system provides a clean front compartment floor, as there are no levers to interfere even in a slight degree with the comfort of the occupants. The advantage of the pre-selection principle is that while the car is being operated in one speed—say high, for example—it is possible to set the selector lever to the notch indicating second speed and on the next movement of the clutch pedal the gear is automatically shifted by positive mechanical means without the motorist's taking his hands from the steering wheel.

No discussion of new features of motor cars would be complete without brief mention of low-pressure, oversize, or balloon, tires, as they are called. The most essential feature of the balloon low-pressure tire is the cushioning effect it gives the machine when on rough roads. It has been found by many experiments that when driving on a very rough highway, with many chuck holes, the car is given a kind of rolling effect instead of jolts that are uncomfortable to passengers and injurious to the car. Of course, the ups and downs of the road are still there, and the car goes up and down with them, but everything is cushioned so that there are no sharp shocks and jolts, and one does not have to watch the road or put his body in a tense condition to get over the rough places, nor be worried about being tossed up from the seat. Furthermore, the driver does not have to pick out all the good places in a

(Continued on page 66)

The Economic Position of Motor Transport

Motor-Vehicle Economy and Mobility as Realized in the Truck and the Bus

THERE is no economic problem of greater basic importance today than the unifying of all means of transportation into one sympathetic system. The urgent necessity of moving people and materials with the utmost expediency and economy has direct and obvious bearing upon the progress of the country financially, industrially and commercially, and, therefore, upon the cost of living generally. Significant present-day developments in transportation are tending unmistakably towards better coordination and cooperation between the four main units: steam roads, electric railway, ships, and motor vehicles. Out of the confusion and friction of the past, an orderly system is being gradually established, to the elimination of wasteful methods and destructive competition. It is hoped that in the near future we will see a new era in this field.

The outstanding factor in the linking of railways, highways, and waterways, is, of course, the rapidly expanding use of motor vehicles. Rail and water carriers are of ancient origin; the amazing growth of the motor industry has taken place in little more than a score of years, and only within the last few years have trucks and buses taken their permanent place as essential transportation units. Yet, in that short space of time a great fleet of trucks has been sent forth on its mission of carrying the products of field and forest and mine to railway platforms and docks and factories, and eventually to stores and homes; an immense fleet of buses and taxicabs has given its contribution to the task of moving millions of persons within cities and between communities, supplementing and extending the service of steam and inland water lines. The cooperation of railway companies has resulted in the development of a special form of motor vehicle adapted to use the railroad right of way.

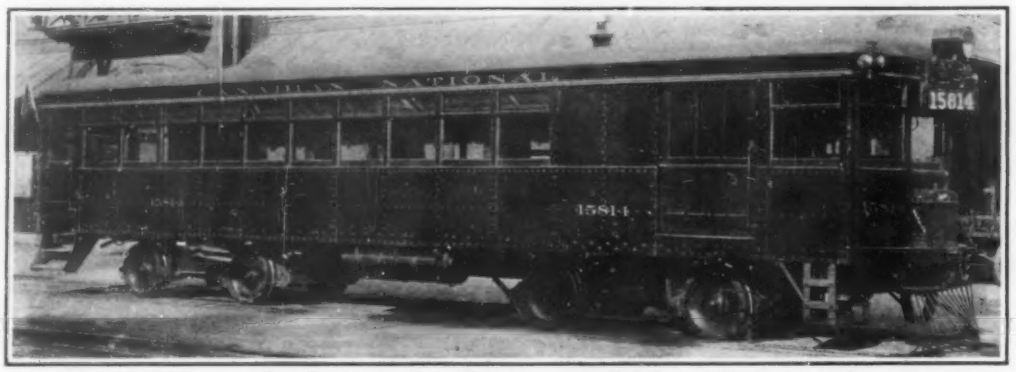
The number of motor vehicles of all kinds in the country has now reached 12,239,114, while production last year reached 2,659,000, an advance of 22 per cent over the previous year. The suburban use of cars and motor trucks is an example. Around our big cities are areas of land used by home seekers. Without motor vehicles only land within walking distance of a railroad station has been readily available. With the motor vehicle each station becomes a center for home development for a radius of several miles. Long Island, a part of the area in the New York Metropolitan District, illustrates this point. In 1917 there were 11,800 motor cars in suburban counties of this island, and there were 50,796,000 passenger fares on the railroads serving the territory. In 1922 there were 41,000 cars, and the railroad passenger total had grown to 79,656,000. In the same period motor trucks increased from 2,482 to 10,000, and the freight carried by the railroads advanced from 5,271,000 to 6,028,000 tons. There have been several thousand new dwellings per year constructed in this region; 1922 set a new mark with 23,336.

The rail lines are not leaving it to private individuals to discover the advantages that may be obtained through developing territory intensively by use of the motor vehicle. Forty railroads are using flanged-wheel motor buses on their short lines. The American Short Line Railroad Association finds that many lines operate these buses at a cost of from 10 to 25 cents a mile, including all charges, as compared with the cost of 65 cents to $1.00 to the rail line in the operation of steam trains. Where only a one or two-car train is needed on the short-line route, the saving in the use of the gasoline car is obvious.

The motor industry now is in the legislative period of its development; a flood of laws and proposed measures, relating to the regulation of these modern carriers of the highway, has followed in the wake of their wider utilization, and legislative hoppers in every state have been jammed with thousands of bills. Without question there has been some wise legislation enacted with the view of promoting and encouraging this newest of giant industries; it is likewise certain that there have been passed many laws destructively restrictive.

While we are long past the days when a man carrying a red flag walked ahead of the motor vehicle to warn other users of the highway of its approach, or those more recently in which Iowa farmers got together in their granges to warn all members against having any business dealings whatever with owners or operators of the modern Juggernaut of the road, the "horseless buggy," there still exists, in the minds of many, misconception of the true importance of motor vehicles and of the attitude of the automotive industry towards legislation affecting its interests. There is much comment, for example, to the effect that passenger cars, trucks and buses are not paying their rightful share of taxation; that public highways are being destroyed by their use; and that unfair competition has been set up against steam and electric roads. That this is not generally true is proven by figures published that show in some states that the motoring taxes are twice the amount spent on road building and repair.

It is not generally understood that the burden of assessment placed against the industry in many states has been out of all proportion to its ability to pay; that the motor vehicle has been the most powerful influence towards the building of better roads, so necessary for economic advancement; and that trucks and buses are in actuality cooperating and not competing units in the transportation system. The public is willing to pay for service, and if motor buses do the work better, quicker and cheaper than other methods, it will necessarily be a case of the survival of the fittest.



The service rail car, an eight-wheel type that follows steam-railroad practice in car and truck construction, and motor-vehicle precedent in power-plant, transmission and change-speed gearing

Nor is it widely understood that, far from opposing intelligent regulation and taxation, the automotive industry has consistently advocated reasonable regulations and the imposition of taxes sufficient to cover the entire budget of State Highway Departments for the maintenance of improved highways. The United States Bureau of Public Roads reports that the total of motor vehicle taxes for 1922 was $334,901,200; in some states the amount of such taxes far exceeded the highway maintenance budget. In this connection, it is interesting to note that one of the largest truck manufacturing companies, which has paid out a total of more than $12,000,000 in dividends over a period of years, has also paid in excess of this sum for State and Federal taxes.

One of the striking aspects of motor vehicle legislation is the wide variation in the licensing fees of the various states, in the basis for fixing fees, and in those elements which are closely related to the cost of highway construction and maintenance, namely, weight and speed of motor trucks. While exact uniformity of regulations and restrictions may not be possible, because of differing local conditions, it is certain that manufacturers and operators of trucks and buses, as well as highway engineers, must be given some fairly standard code, acceptable to the states as a whole, upon which the problems as to weight, speed, and tire impact, may be worked out.

It is being recognized that it is folly to bar the so-called heavy-duty truck from the highways, as has been the endeavor in some states; such procedure would result in the use of two trucks instead of one, with consequent greater damage to the roadways as well as higher operating costs. In the matter of gross weight, there should be a limit, of course; the Motor Vehicle Conference Committee has submitted its proposal for 14 tons gross, and upon this basis highways of the future are likely to be built. It should be recognized, however, that it is the unit weight per inch width of tire supporting the load and in contact with the roadway that counts. Very heavy loads may be carried without injuring the surface if the wheels are of sufficient width.

The chief point to be considered in connection with the highways is that they should be built to carry the necessary traffic rather than so poorly or cheaply constructed as to act as a bar to economical hauling. The public mind should be educated to consider the value of good roads from the standpoint of actual decrease in the cost of commodities, through decrease in the expense of transportation. If it is good business to build a railroad rail-bed so that it is adequate for any demand that may be made upon it, then paved highways should be built to meet the same conditions. The value of paved highways lies in their destruction through use and not in their preservation through uneconomically restricting that use. The only possible use to which paved highways can be put whereby value received can be realized must be commercial use. Political considerations must give way to efficient road construction. The public must receive what it pays for.

State lines should no longer be drawn in transportation matters, and legislatures should act to make uniform highway rules and regulations, together with laws as to licenses and fees, in so far as possible, for the purpose of encouraging transportation and therefore for the purpose of decreasing costs to the consumer. In fact, many people who have given the subject consideration seem to believe that Federal, rather than State, control is what will be necessary. Commercial motor vehicles are here to stay—they have become and will remain absolutely necessary parts of a unified and efficient transportation system—and the expansion of the facilities afforded by their uses should be encouraged by reasonable legislation, rather than retarded by ill-advised prohibitions. It is a shortsighted policy that has prevailed since the beginning of history to attempt to limit and restrict progress by legislation and to judge what would be proper in the future by the limited outlook obtained from a consideration of the past.

Old-fogyism has always been a stumbling block to progress, and if motor transportation is to be circumscribed by hasty and ill-advised legislation, the industrial growth of this country will be proportionately stunted. Upon this belief not only the manufacturers of motor vehicles are agreed, but also an increasing number of rail and water line operators, who are demonstrating, by the purchase and utilization of trucks and buses, the value of these mobile units as adjuncts of their own service. More than 100 electric railways in 23 states now operate more than 1000 buses and feeders and extension units; the use of trucks by railroads for less-than-carload-lot hauling and terminal service is growing constantly, and gasoline-engined rail cars, closely akin to motor trucks, have been the salvation of many companies operating short lines which were unprofitable with steam or electric trains but which now show a profit with the more efficient rail cars. In every state the public, as the buyer of the commodity of transportation as well as the real owner of its properties, should be seeking the enactment of wise legislation to improve its trade arteries and carriers and to safeguard its tremendous investment in them.

Fourteen million passengers were carried in motor buses operating in the State of California during 1923. This figure, staggering in itself, is but an indication of the tremendous strides made in bus transportation during the last few years, bringing the passenger carrying bus into full partnership with the nation's leading transportation facilities. Following closely in the footsteps of California, buses operating in Ohio last year carried nearly 12,000,000 passengers, while bus lines operating in Minnesota report 10,000,000 people carried

over a like period. Records of bus transportation in other states would reveal figures of equal magnitude. The year 1924 undoubtedly will show a big increase in the number of passengers carried.

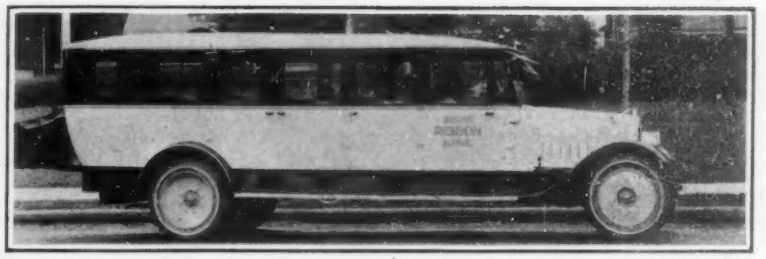
An important trend of bus development, and a fairly recent one, is indicated by the scale on which electric rail lines are purchasing and operating motorbus equipment. A record along this line is believed to have been established by the Pacific Electric and Los Angeles railways in purchasing 81 buses in a single order. Fleets equally large are operated by independent bus companies. Indicative of the place the motor bus is carving for itself, one manufacturer reports that four electric traction companies alone operate close to 200 of its buses in conjunction with street car service, while all told more than 4500 of its vehicles are running on schedules measured and timed by public convenience in every state in the Union.

The motor bus, because of its extreme flexibility, is not limited in its operation but is capable of efficiently serving the public wherever there is need of passenger transportation. Buses are now being operated with much success in city service, as traction line feeders, on inter-city lines, for de luxe tours, for schools and institutions and for parks and sightseeing. They have become within a few years a very definite part of the country's transportation system.

In the four years preceding the war, the ratio of increase in passengers carried on motor buses in London was 136 per cent, as compared with a ratio of increase on the tramways (trolley cars) of only 18.7 per cent. There are over 4000 buses operated in Greater London every day handling an average of over 2,000,000 passengers. Late figures on bus operation in Paris are not obtainable, but those of 1913 show that in that year there were in daily use 1032 buses. The increase in passengers carried on motor buses from 1911 to 1913 was 81.4 per cent, while the increase on subway and trolley lines combined was only 10.2 per cent in the same period.

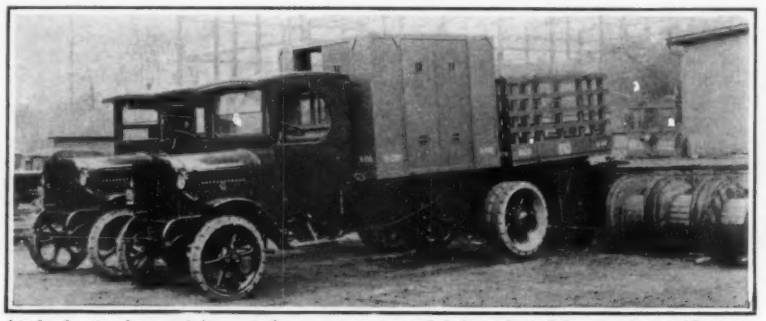
Recent figures on motor bus operation in New York City prove even more conclusively the increasing popularity of the motor bus as a passenger transportation medium. In 1910 passengers carried by buses in New York City numbered 6,503,175. In 1921 there were 51,091,365 bus passengers, or an increase in 11 years of 710.31 per cent. From 1910 to 1918 the increase in the number of passengers carried by the surface lines in New York equalled 8.4 per cent, as compared with the 344 per cent for the motor buses over this eight-year period. With the above figures as a basis for speculation, it does not require an exceptional vision to predict the future of the motor bus. Just as the motor truck successfully proved its economy and dependability as an independent freight carrier, so is the motor bus fast becoming a vital factor in passenger transportation. It is not only serving as an adjunct to city and interurban lines, but is assisting in the development of areas surrounding the larger centers of population heretofore inaccessible to the home seeker.

When the demand for motor buses became great enough, manufacturers who had supplied their regular motor truck chassis for this work learned that the ordinary chassis, so well adapted for commercial use when equipped with a van or dumping body, was not an ideal passenger vehicle when fitted with a bus body. In the first place, the truck speeds were too low, and the chassis frames and springs brought the bus floor too far from the ground. Naturally, as the demand became greater and more buses were put into operation, the factory engineers, working in cooperation with the service men, soon had compiled and digested the experience of the various users; and special chassis designs were evolved that were especially adapted to wholesale passenger transportation. By dropping the front axles and underslinging the front and rear springs, and in some instances by having the frame side members dropped between the springs, buses were evolved that were easy of access and that carried their loads low enough so the low center of gravity permitted higher speed with safety and comfort to the passengers. In the ordinary motor truck chassis, power plant reliability was of paramount importance; but if the engine vibrated at certain speeds or if it was somewhat noisy in operation, these conditions did not seriously militate against its use for hauling a moving van or coal wagon body. When the bus body was mounted, however, the situation was an entirely different one. Vibration and noise were detrimental to the passengers' comfort and therefore objectionable. The modern bus chassis must incorporate features of the passenger car as well as the truck. It must have more refinement of those details making for speedy and comfortable transportation and at the same time it must have that ruggedness of construction to carry its loads safely that is associated with motor truck chassis design.



Typical bus specially adapted for non-stop inter-city runs or for sight-seeing and touring

This has resulted in the development of special spring suspensions and the employment of giant pneumatic tires to secure maximum riding comfort. Bus bodies are sometimes carried by special resilient supports, either in the form of rubber pads or metal spring members attached to the chassis frame. One of the marked improvements of the past year has been the use of rubber shock-absorbers or insulators at the spring ends to replace the usual hinged steel shackle with its spring eyes, bronze bushings, hardened and ground shackle pins, shackle bolts, nuts and grease cups. The natural ability of the rubber insulators to adjust themselves under pressure to constantly varying road conditions relieves the springs of all undue twisting strains so prevalent when the non-yielding shackles of metal are employed. Where these rubber shock-insulators are used it might be said that the chassis frame, including power plant and transmission mechanism, floats upon eight insulators of live resilient rubber which act in effect as though the spring ends were supported by a sensitive though strong molded jelly. It is stated that a life of 100,000 miles is not at all uncommon in the case of the rubber shock-insulators and that when depreciation sets in, but a few hours are needed to make a change or removal of the worn parts. These rubber insulators act to reduce vibration and are stated to result in increased tire mileage.



At the front a box container, at the rear a crate, each being adapted for certain specific types of merchandise

Loading two styles of unit containers on a single truck

Bus body construction has improved just as the design of the chassis has. Fortunately, the engineers charged with bus design had ample previous practice to draw on, and in bus bodies one finds the best features of both the passenger automobile and the trolley or electric car. Drawings of typical bus bodies presented herewith show two types. The seating arrangement of the city type is such that considerable space is provided at the rear by using seats running fore and aft, so that grab stanchions and horizontal grab rails may be used by standers. This combination arrangement provides more standing room than the interior of the suburban type, which has only cross seats and which is particularly well adapted for suburban and inter-city routes. These bodies have window curtains, brass bar window guards for the exterior, roller destination signs and other features found in electric car bodies.

Many railroad lines have lost so much of their passenger traffic to interurban trolleys and highway vehicles that their remaining patrons can be carried in much smaller units than the conventional locomotive and two-car train. Therefore short-line officials are brought face to face with the fact that with rapidly mounting cost of service and decreasing numbers of passengers, it is now, in the majority of cases, no longer a question of showing a profit but rather of how much the operating losses can be reduced. They have accomplished wonders in the way of cutting expenses to the bone, but with steam equipment they are nevertheless waging a losing battle, because the cost of operating even the lightest two-car train is apt to be greater than the revenue from the few passengers carried. Gasoline-propelled rail cars have shown that they can handle light passenger traffic satisfactorily and at much less expense than is possible with steam equipment. Rail cars are capable of providing clean, comfortable, safe and reasonably rapid passenger service and can be operated for approximately one-quarter of the expense of steam equipment. They offer an opportunity of eliminating present operating losses, with a possibility of actually turning them into a profit. In addition to their marked ability to operate economically, these rails cars are instantly popular as a strictly modern conveyance designed for a specific purpose.

Single gasoline-propelled rail cars, in addition to being a practical answer for such situations, are also ideal for operating in new, undeveloped sections that must await the time when traffic will warrant the installation of heavier equipment. Because the capacity is limited to the requirements of a special type of passenger traffic, they can be built lighter than equipment designed for heavy, long-distance loads. This lightness, coupled with the fact that the speed does not exceed 40 miles per hour, permits the use of moderate power—and moderate power means moderate costs. Where the traffic is too heavy to be carried on one car, it is frequently practical to run two cars and at the same time give the public the advantage of a more attractive schedule, at an operating cost that does not exceed half that of a single steam train.

Where the usual train is composed of separate pulling and trailing units, great weight of the pulling unit (which carries no useful load) is necessary to secure traction, and correspondingly robust construction is essential in each part in order that it may withstand the shocks of coupling. In the rail car all of the useful load contributes directly to the traction for both driving and braking, permitting a corresponding reduction in the dead weight. This advantage, in addition to a total absence of coupler impact, plus the use of anti-friction ball and roller bearings, alloy steels, aluminum and pressed steel sections, assures heavy-duty characteristics with the economy of light weight. The rail car is not a motor truck. Nevertheless, in its construction are employed many principles of engineering and mechanical parts which are the result of highway transport development.

Space is not available to describe the many structural features of rail cars, but suffice it to say that many of the components, especially the power plant and transmission, are modified from similar components of motor trucks. The engines are similar to truck engines, and

Radically different bus from the one pictured above, designed for city use where frequent passenger stops are made

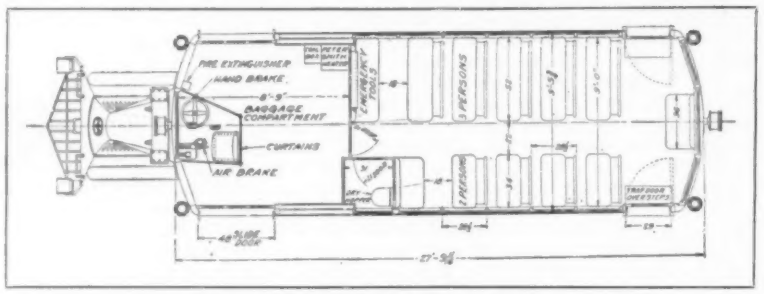
in the Mack A C the bore is 5 inches and stroke 6 inches, of the regular four-cylinder type. A single-plate clutch and a main four-speed transmission of the selective type are used. Between the engine and the main transmission is an auxiliary reverse transmission which serves to change the direction of rotation of the drive shaft when it is desired to reverse the car. This provides as many reverse speeds as there are forward speeds available. When operating the car in a forward direction, this auxiliary reverse transmission is idle.

It is in the chassis and axle details that the rail cars differ most from motor trucks. The Mack A C and A B rail cars are six-wheel designs, the front of the chassis being supported by a four-wheel truck similar to those used in railroad practice. The Mack A H and A C X models are eight-wheel designs, both front and rear being supported by four wheels. Figures show that the cost of operation of the A B model, which has a four-cylinder engine of 4¼-inch bore by 5-inch stroke, and which is lighter and of less capacity than the A C types, is about 21 cents per car mile with a one-man crew; while the larger car, with a two-man crew, costs about 50 cents per car mile. The smaller car may carry as high as 30 persons, and as the rate can be three to four cents per mile per passenger, and even more, it will be seen that a profit is easily returned even if the car does not carry its full capacity on all trips. The A C car may have seating arrangements for 46 persons if no baggage compartment is provided, so its profitable operation is only a question of proper scheduling to insure full passenger loads. The larger car has a speed of about 40 miles per hour on the level and will climb a 4 per cent grade at ten miles per hour. The A B car has a maximum of 28 miles per hour on the level and will climb a 4 per cent grade at seven miles per hour. The acceleration of the more powerful car is to 30 miles per hour in 61 seconds; the smaller can attain a speed of 25 miles per hour in one minute's time. The deceleration is the same on both models, or two miles per hour per second.

The rear axle is similar to an automobile axle of the full floating type. It consists of a cast-steel housing, with forged-steel extensions, inclosing the driving gears and axle shafts. The drive is transmitted by a single set of large bevel gears driving without a differential, through splined axle shafts, which in turn are splined into the combination hub caps and driving plates on the outside of the wheels. The wheels are steel castings with shrunk-on tires. They are separate from the hubs, being bolted in place. Two long semi-elliptic springs are bolted directly to the rear axle, just inside the wheels, which support the frame. These, like the leading truck springs, are equipped with rubber shock-insulators at their tips. The shock-insulator consists of a cast steel box riveted to the frame, which receives the tip of the spring between blocks of rubber. Pressed steel cups are riveted to the spring tips, which fit the inner ends of the blocks. The elongation and shortening of the springs, due to their deflection, is thus taken care of by the kneading action of the rubber. This eliminates much of the friction and, therefore, the need of lubrication at these points, and, furthermore, provides a cushion to absorb all of the minor shocks and vibrations, insulating the frame from the springs.

The four-wheeled leading-truck supports the front end of the car through two long, semi-elliptic leaf springs. These springs are set longitudinally and seated on a heavy cast-steel body bolster. This body bolster is pivoted to a cast-steel swing bolster, which is slung under the leading truck frame by links and extended to form side bearings for the body bolster. The leading-truck frame is made of pressed chrome-nickel channel-steel like the chassis frame, the various fittings being drop-forgings and steel castings. Axles are fixed, being made of chrome-vanadium steel. The wheels, which are steel drop-forgings, turn on tapered roller-bearings. The frame side-members are heat-treated chrome-nickel steel pressed into shape. All holes in the frame are drilled (not punched) and all frame members, brackets, etc., are hot-riveted. All steps, grab-handles, etc., are made in accordance with the latest requirements of the Interstate Commerce Commission.

The air brakes embody a compressor equipped with an unloader and driven off the four-speed transmission countershaft, compressing the air in two large-capacity tanks fastened to the chassis frame. The air-control valve is operated from the driver's seat and applies the brake shoes on all wheels simultaneously. A large serviceable air-gage is mounted on the dash in front of the operator. A hand-brake staff with a standard non-slipping rubber wheel, together with a ratchet and pawl, is provided at the front end of the car. This staff applies the brake shoes on the rear wheels, and is used for emergency purposes or for holding the car on a grade overnight.



Ground plan of a typical eight-wheeled rail car

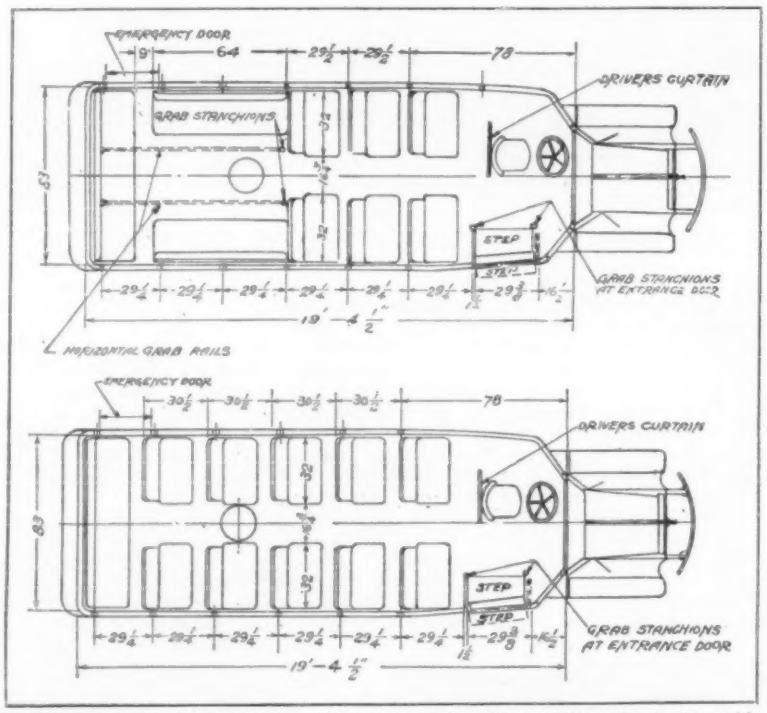
Unit containers, usually thought of as individual boxes, which can be loaded and sealed by the shipper, transported to the consignee on truck chassis, freight-car, boat, or all three, without disturbing the contents, offer great possibilities in the coordination of all transportation facilities and the expediting of freight movement. The outstanding instances of unit-container use in this country are to be found at Cincinnati, Ohio, and on the New York Central Railroad lines.

The demountable body in various forms is in use to a limited degree in many parts of the country, and is probably more adaptable for general purposes of motor-truck cartage than the unit container. In other words, we can say that the unit container is commonly referred to in connection with traffic interchange between rail and road vehicles, whereas what we usually term a demountable body or flat is more often used simply for interchange between motor truck and loading platform. As a matter of fact, to all intents and purposes a unit container is a demountable body when used with a motor truck, and a demountable body or flat can easily be used in an ordinary flat-car on rail movement. The container-car, however, is one fitted to accommodate a definite size and definite type of container, and is not intended to be used with any other equipment.

The practicability of the unit container has already been proved by experimentation in both this country and in Europe. The unit container known as the "Lyons" type is the best and most up to date type. Its unladen weight is only two-fifths that of an oak container of equal capacity. It is constructed of duraluminum, a material similar to that used in the German Zeppelins. The New York Central type of container was designed primarily as a unit that would fit a special flat-car, but of a weight and size easily adaptable to the conventional motor-truck chassis equipped either with or without a body.

Other types of unit containers are glass-lined tanks, such as are used on the New York Central lines, and adaptable for milk and other liquids that can be shipped in bulk; while containers for household goods, tobacco products, confectionery and other commodities carrying a high tariff are in use in various parts of this country and Europe in a very limited way. One of the greatest advantages of a flat or demountable body recently developed is that it can be transferred to the truck chassis either from the ground or the loading platform with equal facility by power derived from the truck engine, and in addition can be hauled on and off an electric or steam railway flat-car by the same method. Moreover, in effecting the transfer no overhead cranes are necessary, which means economy in cost of operation and space used at warehouse, and at

(*Continued on page 68*)



Referring to the photographs of page 11, the upper of these drawings shows the city type with seating accommodations subordinated to sheer carrying capacity; the lower represents the suburban or inter-city type, in which the aim is to provide each passenger with a seat

Two types of seating arrangements for bus bodies

Something New in Automobile Drives

SOMETHING decidedly new and surprising has been sprung on automotive engineers of Great Britain by Mr. G. Constantinesco, who will be recalled as the inventor of the wave-power method of transmission, described in these columns several years back. Mr. Constantinesco's latest surprise is an automatic variable gear or torque converter, as he terms it, torque being best described for the non-technical reader as "turning effort." It is probably the most revolutionary device yet introduced into the evolution of the automobile, since it renders unnecessary the clutch, the transmission gears, and the usual rear axle drive, of which the transmission is easily the most backward feature in the modern car.

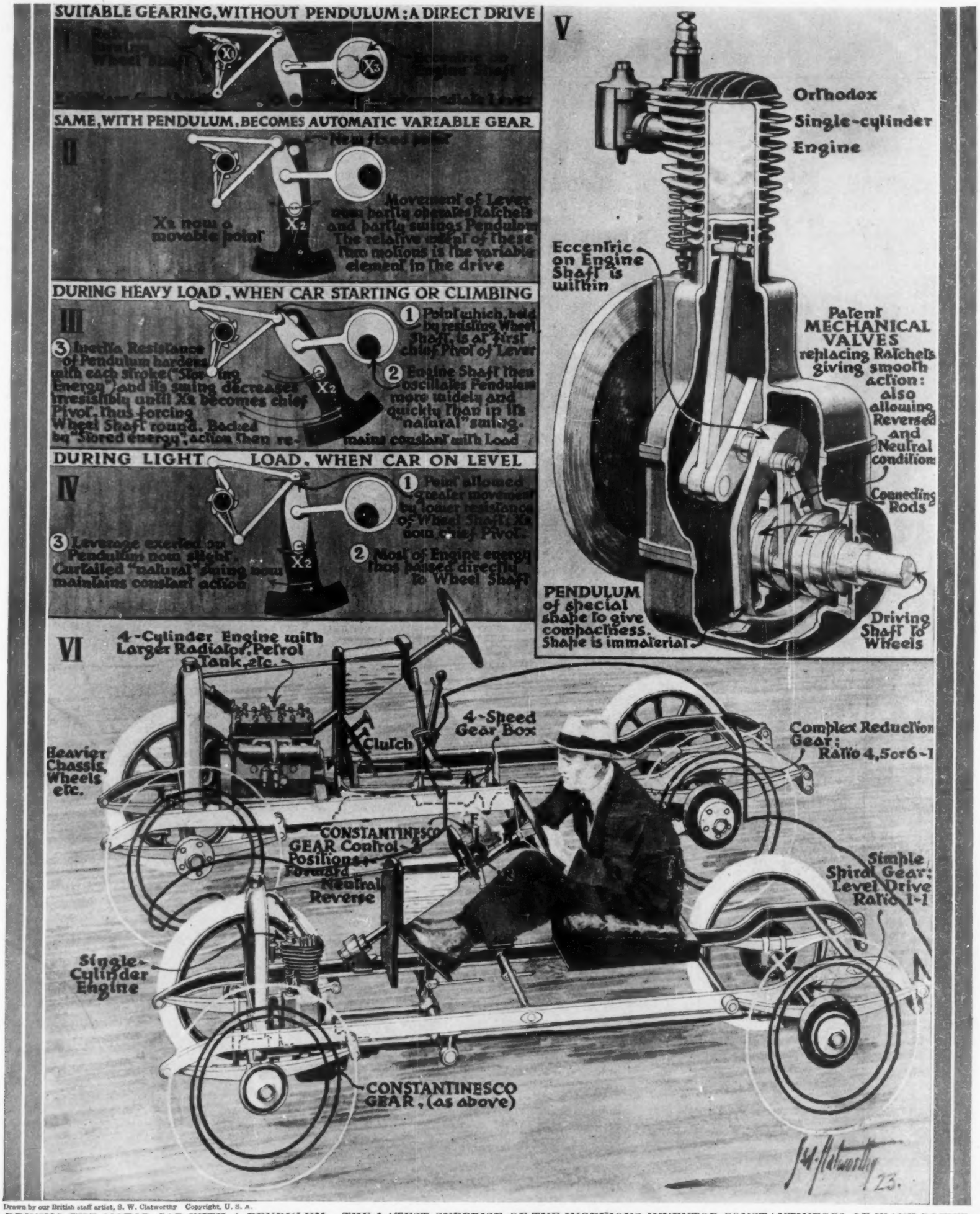
The essential feature of Mr. Constantinesco's invention, as shown in Figs. I and II on the facing page, is a pendulum introduced between driving shaft and driven shaft, which perpetually adjusts the engine output to the load, or the varying resistance of the wheels.

All pendulums have a "natural" rate of oscillation, and interference with this sets up the reaction on which the invention depends; the free swings become, as it were, arrested side-to-side jerks, or unduly prolonged thrusts. Its action is explained in Figs. III and IV. The device is not so difficult to understand. Common sense suggests that the engine would merely waste its power in a futile wagging of the pendulum, instead of which the reaction actually accumulates or stores energy in exact proportion to any increased resistance by the driven shaft.

Fig. V shows Mr. Constantinesco's first design for an automobile engine unit and demonstrates how neatly it can be incorporated. Fig. VI shows the striking difference between the resulting chassis and a normal example of equal capacity with which it is compared. The big power of the latter's engine is required only at the rare intervals of starting and climbing, and is wasteful at all other periods.

Control is simplified: the motorist, at starting, merely sets the gear lever from "neutral" to "forward" and forthwith forgets there ever was such a nuisance as three-speed transmission. The special "Mechanical valves" seen in Fig. V, at present secret for patent considerations, render the action quite smooth and noiseless, entirely eliminating the jerks which usually accompany gear-changing, and allow of rapid reversals even under full load.

In a recent demonstration a drive of this kind operated a motor truck with but a 10-horsepower engine instead of the usual 20-horsepower engine, carrying ten men and towing a four-ton trailer.


SUITABLE GEARING, WITHOUT PENDULUM: A DIRECT DRIVE
I
SAME, WITH PENDULUM, BECOMES AUTOMATIC VARIABLE GEAR
II
X2 now a movable point
Movement of Lever now partly operates Ratchets and partly swings Pendulum. The relative speed of these two motions is the variable element in the drive
DURING HEAVY LOAD, WHEN CAR STARTING OR CLIMBING
III
1 Point which, held by resisting Wheel Shaft, is at first chief Pivot of Lever
2 Engine Shaft then oscillates Pendulum more widely and quickly than in its "natural" swing.
3 Inertia Resistance of Pendulum hardens with each stroke ("Storing Energy") and its swing decreases irresistibly until X2 becomes chief Pivot, thus forcing Wheel Shaft round. Backed by "stored energy" action then remains constant with Load
DURING LIGHT LOAD, WHEN CAR ON LEVEL
IV
1 Point allowed greater movement by lower resistance of Wheel Shaft: X2 now chief Pivot.
2 Most of Engine energy thus passed directly to Wheel Shaft
3 Leverage exerted on Pendulum now slight. Curtailed "natural" swing now maintains constant action
V
Orthodox Single-cylinder Engine
Eccentric on Engine Shaft is within
Patent MECHANICAL VALVES replacing Ratchets giving smooth action: also allowing Reversed and Neutral condition
Connecting Rods
PENDULUM of special shape to give compactness. Shape is immaterial
Driving Shaft to Wheels
VI
4-Cylinder Engine with Larger Radiator, Petrol Tank, etc.
Clutch
4-Speed Gear Box
Complex Reduction Gear: Ratio 4, 5 or 6-1
Heavier Chassis, Wheels etc.
CONSTANTINESCO GEAR Control Positions: Forward Neutral Reverse
Simple Spiral Gear: Level Drive Ratio 1-1
Single-Cylinder Engine
CONSTANTINESCO GEAR, (as above)
J.W. Clatworthy '23.

Drawn by our British staff artist, S. W. Clatworthy Copyright, U. S. A.

DRIVING THE MOTOR CAR WITH A PENDULUM: THE LATEST SURPRISE OF THE INGENIOUS INVENTOR CONSTANTINESCO OF WAVE-POWER FAME.—(See facing page for description)

Our Point of View

REVIEW OF THE YEAR, 1923

Civil Engineering

IT IS our custom in this review to treat civil engineering by itself, covering the progress in mechanical engineering under the various divisions of the broad field which it covers. In civil engineering, progress has been confined to the carrying on, for the most part, of works already in hand, and as usual it has been concerned mainly with water supply, irrigation, and the permanent works needed for the enlargement of transportation facilities. Gratifying progress has been made on the Hudson River vehicular tunnel, the first venture of this kind on so large a scale. Work also has been started on a freight and passenger tunnel beneath the Narrows in New York Harbor. The Panama Canal, thanks to the huge shipments of oil from California, is showing a remarkable increase in traffic; we wish that a similar growth could be recorded for that great waterway, the New York State Barge Canal, which is suffering from its long disuse during reconstruction. Shippers seem to forget that the parent Erie Canal, whose centenary was celebrated last year, was the principal agency in the early growth of the Port of New York. Of new railroads construction there has been practically none; the engineer has been occupied in adding tracks to existing roads rather than building new ones. There is an increasing demand for water supply and irrigation. Rapid progress has been made on the Schoharie Dam in the Catskill Mountains, and two additional pipe lines, each eleven feet in diameter, are being laid along the lines of the Catskill aqueduct, by which an additional 250,000,000 gallons of water per day will be available for New York City. The Shandaken Tunnel eighteen miles in length for conducting the Schoharie water into the Ashokan reservoir, was completed during the year. Of large bridges, that across the Hudson at New York is awaiting favorable action by the War Department, and work has commenced upon a great highway suspension bridge across the Hudson at Bear Mountain, which will have a main span of 1632 feet. Although the proposed crossing of San Francisco Bay, which will call for one of the world's greatest bridge structures, is still in the preliminary stages, undoubtedly this work will be put through; so necessary is it to the convenience and local development of San Francisco and its various great suburbs across the Bay. Reinforced concrete bridges are being built in increasing numbers and of increasing size. The low cost, speed of construction and architectural beauty of this type of bridge are bringing it into increasing use. Among notable examples of concrete bridges, we have recorded and illustrated the handsome Georgetown arch bridge at Washington, the concrete-covered steel arch bridge of 360-feet span across the Willamette River at Oregon City, the rebuilding, in concrete, of the great Harrisburg bridge, and the construction of the very beautiful bridge between Detroit and Belle Isle, with its many graceful elliptical arches.

Pure Science

As usual, the quiet current of the year's doings in this field concerns itself with the investigation of the physics of the atom, and as a result of the work done during 1923, we are appreciably closer to a clear understanding of the bond between electricity and matter, the electrical and spatial properties of electron, proton and atom, and in general "the nature of things." Extremely valuable is the work, as yet unpublished, in connection with the hitherto-imperfectly-understood spectral lines of the elements. We appear to have a rock-ribbed mathematical formulation of the location of these, in terms of other numerical properties of the atom; and while as yet the matter remains on this strictly empirical basis, with no hint of the underlying mechanism of cause, the latter will doubtless follow—and even should it not, a complete empirical formulation is of itself a tremendous gain.

If the quiet current of orderly scientific progress remains undisturbed in its direction for 1923, as compared with previous years, there has been at least one occasion on which the stream has overflowed its banks at an unexpected point. The Japanese earthquake has brought about a great revival of interest in seismology, geology and the allied sciences, with the eminently practical aim in view of enabling us to forecast the probable occurrence of such catastrophes; and there seems ground for asserting that sufficient new light on the underlying causes of the earth's uneasiness has been obtained to lead to the hope that the aim may be in part realized.

Psychic Research

For the first time we dignify this branch of science with separate consideration under a formal heading of its own. It is one in which progress is necessarily slow, because of the dearth of experimental material. Good mediums are scarce, and good mediums who have the temperament enabling them to work profitably for scientific investigators are even rarer. But there appear to be a few of these, and with them the collation of data proceeds—it would, of course, be extremely rash to advance any claim that the investigation of psychic phenomena has proceeded beyond this stage.

Our own investigation has, to date, been disappointing in that no genuine manifestations have been brought before our committee. Other workers have been more fortunate, and in Great Britain, the body of investigators working with the medium Stella C. has had the singular good fortune of being able to prove categorically the existence of a manifestation that has been freely disputed—the cooling influence of the mediumistic trance upon the immediate neighborhood. Seances have been held in a locked and sealed room, sufficiently insulated against all influencing of the temperature from without. Obviously, under the operation of known causes, the only thing that can happen to the room temperature is a slight rise, from the heat-radiation and combustion products of the numerous persons present. Actually, this did occur, in the end; the temperature at the close would always be slightly higher than at the beginning. But the verdict of the sitters' senses that the room was materially cooler during the mid-portions of the seance was checked up by self-recording thermometers, and found to be in accordance with the facts. This cooling was always appreciable; in two or three instances, the bottom of the temperature curve, corresponding with the climax of the trance and the other phenomena, was no less than twenty degrees Fahrenheit below the initial figure. There seems no escaping the conclusion that we have here a genuine psychic phenomenon—that the medium in some way absorbs large quantities of energy from the surroundings, giving it back later on. By no possibility can the conclusion be avoided that this iron-clad series of observations is the event of the year in psychic science.

Our Abrams Investigation

During the past year the SCIENTIFIC AMERICAN has found it necessary to engage in another investigation, this time of the electronic reactions of Abrams method of diagnosis and treatment of disease, which has attracted world-wide attention and has caused one of the bitterest controversies yet waged in medical circles.

That a drop of blood gives off certain emanations and that these emanations when properly gathered, tuned in and led to the delicate nerve centers of a healthy human being, will cause certain reactions, and that these reactions enable a 75 to 90 per cent accurate diagnosis of the past, present and future health of the person from whom the drop of blood was taken, is the basic claim made by Dr. Albert Abrams of San Francisco, the discoverer and dean of the E. R. A. technique.

Taken at its face value, and considered in the light of present-day science, E. R. A. technique is fantastic and irrelevant. Nevertheless, the wide application of this method, the thousands of doctors who are now using it, the public's interest in the work of Dr. Abrams, and other important factors make it becoming in the SCIENTIFIC AMERICAN to conduct a thorough and far-reaching investigation so that the truth may be found and made known.

Radio Communication

Radio communication has maintained its unrelenting march of progress during the past twelve months. Not only have there been marked advances in the popularized form of radio, known as broadcasting, but also in the serious, vitally important, workaday ship-to-shore and shore-to-shore communication which goes on steadily without attracting much attention.

In everyday radio communication, the past year has been marked by an increase in the number of high-power stations, proving again that radio is firmly established in the commercial world as a means of rapid and dependable communication. Then, too, there have been various innovations by way of improved codes and automatic transmitters and receivers, having for their object the speeding up of radio traffic. These are radio's answer to the challenge of the cable companies, which have also engaged in speeding up their traffic by improved cable design and equipment.

Some progress has been made in the battle with the arch enemy of radio—"static"—the "noises of space," which at times interfere seriously with the handling of radio business. Other problems also have received their due share of attention during the year just closed.

But it is in radio broadcasting that the marked progress has been made. Looked upon as a fad in the beginning, radio broadcasting has now intrenched itself pretty firmly in the routine of American life. This is due to the commendable efforts of the broadcasters who, during the past twelve months, have been steadily improving their programs. Radio engineers have given us better and better acoustics until today the radio music is quite on a par with the best phonographic reproduction. The Government has given a hand by way of new legislation, which has served to clarify the wave-length muddle under which radio broadcasting labored at the beginning of the past year. Then, too, the number of broadcasting stations, which reached the high-water mark in excess of 800 last June, has been steadily declining ever since, making for better radio broadcasting through the elimination of much unnecessary interference.

At the receiving end the work of the engineers has been very much in evidence. Better vacuum tubes have been introduced, as well as better transformers to provide better music from better loud-speakers. New circuits have made their appearance, causing many of the old circuits to become obsolete. Most important of all, however, the radio industry has introduced the radio receiving set in the form of a true household article, by enclosing the set in an attractive cabinet, making it entirely self-contained and removing all traces of radio. Thus the radio receiving set of this kind, known as the "furniture radio," has been brought into the finest of living rooms, there to take its permanent place beside the piano and the phonograph. That is the significant thing in the radio history of 1923.

Railroads

Although as noted above, there has been practically no new railroad construction, there has been as great activity as limited funds permit in the construction of additional tracks on congested stretches of roads, and in recovering all roadbeds and track from the sad state of deterioration into which they had fallen during their administration by the United States Government. Great credit is due to the railroad executives for the vast economies they have achieved, and the substantial betterments which they have been able to make in the face of lower rates and general labor troubles. For the first time in many years, the total length of track in the country has fallen below 250,000 miles. In June, 1913, the United States possessed 253,470 miles of

Our Point of View

track; on December 31, 1916, there were 259,705 miles; but at the beginning of 1923 there were only 249,231 miles of single track. The hard times which the railroads are passing through is demonstrated by a comparison of the number of cars and locomotives built. Cars and locomotives wear out; they must be replaced quickly and continuously. In 1898, 2,475 new locomotives were built; in 1906, 6,952, and in 1913, 5,332; whereas in 1922 only 1,303 locomotives were built. Again in 1914, 3,691 new passenger cars were added to the equipment; in 1922, only 747. In 1913, 207,684 new freight cars were built and in 1922 only 66,747. These figures show the futility of a further reduction of freight rates. In railroad cars there is continuous substitution of steel for wood. Locomotives have apparently reached the limit of size; but there is considerable activity in the development of new types designed to equal the work of the steam locomotive on a smaller consumption of fuel. Notable among these, is a condensing turbine locomotive built for the Swedish railroads, which, in competition with steam locomotives, hauling express trains of the same weight, has reduced the coal consumption by 50 per cent.

Automobile and Motor Truck

In both the automobile and the motor truck we have the most perfect mechanical device of the present day. The automobile, in its passenger carrying capacity in proportion to its weight, its low consumption of fuel, its reliability and general comfort, stands far in the lead of any modern means of travel. The same high praise may be justly given to the motor truck in its own particular field of work. The improvements of the future are foreshadowed in such devices as the four-wheel brake and the preheating of the charge, both of which in their limited application have given excellent results. To render the automobile absolutely perfect, there should be developed some automatic method of varying the richness of the mixture to meet the changing conditions of load; and some genius should develop a substitute for the present shifting gears, or what is sometimes called a "gearless gearing." In spite of the enormous number of cars, the automobile industry continues to grow by leaps and bounds. Inevitably this has brought serious problems of traffic control in our cities and even on our highways. The automobile interests realizing this, should lend every possible assistance in the development of the best workable plans for traffic control. The time approaches (indeed it has already arrived) when Federal laws for the control of highway traffic should be set in force. Legislation of this kind is a natural corollary to Federal aid in the construction of highways. We need unified laws that will apply everywhere throughout the United States. The rapid growth of the automobile industry in this country is shown by the fact that at the present writing we have about 12,500,000 cars in the United States and over 1,000,000 in New York State alone.

Merchant Marine

The year 1923 has failed to bring about that revival in shipping affairs which the world so greatly needs. The continued stagnation is due largely to the unsettled conditions in Europe. Until the problems of that continent are settled and industrial activity returns to something like normal, shipping will remain more or less in its present stagnant condition. Our own problem revolves around the Shipping Board, and the close of the year finds us apparently as far from a satisfactory settlement as we were at its beginning. The consensus of opinion among our experienced shipping men is that the Shipping Board should be dissolved, and that the Government ships should be sold outright or turned over to private operators. It begins to look as though this would be the solution ultimately adopted. The event of the year in the United States was the going into commission of the "Leviathan" and the excellent showing which it is making in the Atlantic service. On her last trip from Cherbourg to New York, she captured the record by making the run in five days, seven hours and twenty minutes with an average speed of 24.17 knots, her longest day's run being 617 knots. In the "Leviathan" and "Majestic" of 64,100 and 64,800 tons displacement, we have reached a size which probably will not be exceeded for many years to come. The serious problem of dock accommodations will tend to keep down the size, and the future ocean-going passenger ships will be contented with a maximum displacement of about 35,000 tons and a speed of about eighteen knots. As regards new construction, the most notable fact is the steady increase in the relative number of Diesel-engined as compared with steam-driven ships. There are several varieties of Diesel engines on the market or in course of experimental development; and of these, the Still engine, which makes a combined use of gas and steam is the most interesting and original. The two-cycle engine is being very fully exploited, and the probabilities are that within a few years the internal combustion engine will have shown such an all-around superiority that it will have complete possession of the field, except in ships designed for special lines of service.

Naval and Military

The outstanding event during the year in Naval affairs was the signing by France of the Washington Treaty for the Limitation of Naval Armaments, thus rendering this epoch-making compact effective. All the nations concerned have now either destroyed or are engaged in breaking up the ships whose removal is called for by that treaty. Its beneficial effects are seen in the perfect quiet which has taken the place of the angry storm which threatened to break forth in the Pacific. Encouraged by this success, the United States should now call the nations of Europe together, with a proposal for a similar reduction of land armaments. We insured the success of the Washington Conference by our own large contribution to the reduction of naval equipment. If we approach Europe in the same spirit, we believe that Europe would make a quick response. This might take the form of a promise to ease the financial burdens of the European nations, on the condition that they will cut down their armies, stabilize their currencies, and balance their budgets. The reduction of armies to a reasonable figure would relieve these nations at once of a heavy burden of expense, and the combined effect might well lead to an early and satisfactory settlement of the reparations problem. Naval ship construction has been confined to the building and completion of such vessels as were permitted by the Washington Treaty. Great Britain has two such ships on hand, and during the year we have put in commission the "Colorado" and practically completed the "West Virginia." These two ships, with the "Maryland," constitute the three largest and most powerful battleships afloat. The Naval Treaty took no account of unarmed ships, and the United States Navy is relatively weak in cruisers. The country should urge upon Congress the construction of the 10,000-ton cruisers recommended by the General Board of the Navy. Without them our fleet is badly out of balance. Several of our fast 34-knot 7500-ton scout cruisers have been commissioned during the year, and all of them have exceeded their contract speed. During the year the Army Bureau of Ordnance has done notable work in the development of new types of guns of great power, range and flexibility, that are superior to any existing types abroad. Equally good results have been achieved in the development of military tractors and motorized artillery.

Aeronautics

The brilliant achievements of the Army, the Navy and a few of our private firms in the field of aeronautics is at once a great credit to the nation, and a standing rebuke to the parsimony and indifference which Congress has shown to the development of this new art. The close of 1923, found this country in the possession of nearly all of the records for flight. The Naval Air Service, in winning the Pulitzer prize, placed this country far in the lead by maintaining an average of 243.67 miles an hour over a triangular course of 200 kilometers with a Navy-Curtiss racer; and this is only one of a series of records which have given this country its unmistakable lead in international competition. The Transcontinental Air Mail Service has achieved remarkable results by introducing a continuous night-and-day service between New York and San Francisco. On August 23rd, the mail was brought from San Francisco to Mineola, N. Y. in twenty-six hours, fourteen minutes. On the following day, another batch of mail arrived in twenty-six hours, seventeen minutes. Equally gratifying has been the performance of our first dirigible of the Zeppelin type, the "Shenandoah," built by the Navy and flown by the Naval Air Service in a series of long-distance flights, every one of which has been completed without mishap. This ship has proved to be, in every respect, a great success. It marks a new era as being the first Zeppelin to be entirely filled with helium gas. The very successful airplane meet, carried out late in the year by the Army Air Service at Mineola, was a revelation to the public of the great advance which has been made in speed and controlability of the latest types of machines built for Army service. Nevertheless, in spite of this brilliant work, to which a few patriotic private firms have so greatly contributed as designers and builders of airplanes, the Government of the country is showing a lack of appreciation that is positively astounding. Congress has failed, in spite of urgent appeals, to take any steps towards the passing of those laws for the regulation of flying, which are so urgently needed both for the encouragement of aviators and for the protection of the lives of the pilots, the passengers, and the public at large.

Electricity

One of the great problems in the electrical world today, is that of developing the latent waterpowers of the country through a comprehensive and thoroughly coordinated scheme, which will develop the maximum amount of power with a maximum possible distribution at a reasonably low cost. For some years, there has been presented for consideration what is known as the Super-Power scheme, which covers the leading manufacturing section of the country lying between Canada and Washington, and reaching from the Atlantic coast to the Alleghany Mountains. This plan, if carried out, will develop the waterpower of the St. Lawrence River, of Niagara, and of the other lesser streams and rivers; will establish large central power stations in the neighborhood of the various coal fields, and will gather into one great consolidation the present widely scattered, private, hydro-electric and steam-electric powerplants. It will feed the aggregate power thus secured into one great system of distribution, from which the users will draw their power as and where it is required. The economy thus secured represents the annual saving of over 150,000,000 tons of coal. The transmission line problems have grown with the stretching process, and they have come in for a large share of the researcher's attention. The past year has been marked by a continuation of the million-volt experiments of the preceding year, with the result that, aside from the spectacular, much practical information has been gained.

Interesting progress has been made with carrier-current telephony and carrier-current control. By means of a carrier current, it has been possible to telephone over high-power transmission lines, over street-car trolley wires and tracks, and over lighting circuits. The past year has witnessed the introduction of carrier-current telephony over long-distance transmission lines, for ensuring communication between the main generating station and sub-stations, and also over lighting systems for the purpose of bringing "wired wireless" music and talks into the home of electric light consumers. Also, it has been demonstrated that carrier current can be employed for controlling operations at a distance.

Our Abrams Investigation—IV

Odds and Ends Gathered from an Avalanche of Correspondence and Several Interviews

By Austin C. Lescarboura

Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

THE truth or the falsity of the claims made for the Electronic Reactions of Abrams Technique, otherwise known as E. R. A. for short, will never be settled by argument, so far as the thinking public is concerned. Despite tons upon tons of literature; despite thousands upon thousands of testimonials of wonderful cures; despite bitter attacks on E. R. A. based on superficial examination of the claims and upon an incomplete study of the technique itself on the one hand, and laudatory articles based on blissful ignorance of the limitations of the technique on the other; despite demonstration after demonstration made under conditions over which the investigators have little if any control, the world still waits for clean-cut, positive, and understandable evidence based on rigid, impartial, yet thoroughly convincing, tests.

The burden of proof is on those who claim that a new reaction-producing energy has been discovered and harnessed. We are told by Dr. Albert Abrams of San Francisco, the originator of this new technique of diagnosis and treatment, that by securing a specimen of human blood the size of a nickel on a piece of white blotting paper, and then placing this blotting paper in an electronic circuit, so called, properly grounded and including in its path a healthy human being, the electronic diagnostician can, by "percussing" the abdomen of the human being or "reagent," determine the sex, the condition of health, the diseases present, if any, and the potentiality and location of the diseases or infections in the body of the person from whom the blood specimen was originally taken. It will be noted that this is a diagnosis by proxy, so to speak, although the patient himself or herself can be diagnosed in person, if preferred.

The claims are fantastic. Everyone admits as much. They are certainly not in accord with standard electrical practice, although wires, rheostats, resistance windings, ground plates and other paraphernalia strongly suggestive of electrical equipment are employed, and electrical terms, such as ohms, are freely used. The claims are far removed from orthodox medical science; indeed, Abrams announces in no uncertain terms that orthodox medicine is bankrupt at this very moment! The claims baffle the scientist; he is either bound to say that a drop of blood cannot give off emanations which will tell everything about the person from whom it was taken, including even an infection under a certain tooth and a statement of the religion and the racial strains if need be, or he is simply bewildered, as when he sees the clever conjurer pull out a pair of rabbits from a perfectly proper silk hat. He is far from convinced of the validity of the claims, but, at least, he cannot say just how it is done.

The blood specimen from the patient is placed in the dynamizer, shown at the right. The emanations from the blood specimen are gathered and conducted to the healthy human subject or "reagent," who faces west, by means of the "proximal" electrode. These emanations set up certain changes in the hollow organs of the "reagent's" body, which may be detected by percussing, as shown. The nature of the diseased condition of a patient, represented by his blood specimen, is determined by the "vibratory rate," which is obtained by the first resistance box, known as the "vibratory rate" rheostat. The location of the diseased condition is determined by means of the second or "strain rate" rheostat. The potentiality of the disease is read off in ohms on the third or "measuring" rheostat. All resistances are connected in series. The patient is diagnosed by proxy, so to speak.

How the E. R. A. diagnosis is conducted with the usual blood specimen

It seems strange that these "emanations" of the human blood and of drugs and of diseased tissue should have escaped the attention of prominent scientists throughout the world. So much work has already been done on the electronic theory that surely this phase should long ago have come in for its due share of attention. It deals with human life itself, than which there is nothing more important. Then, too, it seems strange that these electronic reactions should be detected and classified by means of relatively crude rheostats which, upon laboratory test, often prove inaccurate so far as their electrical values are concerned. Yet the diagnosis is based on ohmage, not only for the identification of the diseases but also for the degree of affliction.

Let us see what the claims are for this E. R. A. technique. They may be summed up as follows:

1. All substances give off radiant energy. Unfortunately, several substances may give off the same kind of energy, which complicates the matter.

2. The energy from the blood of an individual represents all the attributes of that individual, including his disease processes.

3. Each disease and attribute gives off its own peculiar kind of energy.

4. These energies can be transmitted by metallic conductors, can be differentiated from each other by means of coils of wire having different degrees of resistance, and the potentiality of each energy can be estimated by arbitrary units of measurements.

5. Each of these energies, when conducted to a living human subject known as the reagent, causes definite reactions that identify the energy.

6. The reactions have to do with slight changes in the tone of some of the hollow organs of the body, or at least a change that can be detected by delicate percussing, by rubbing the superimposed surface of the body with a glass or hard-rubber rod, or by a difference of texture of the skin as detected by the fingers, and at times by a change in color of the skin over the organs in which the reaction takes place.

7. These energies are of a vibratory character and each disease has its own particular vibration.

8. Certain drugs have a similar vibration to certain diseases and therefore those drugs have a destructive action on the diseases to which they correspond, in accord with well-known physical laws.

9. An instrument called the Oscilloclast, or "wave smasher," has been devised by Abrams and it is claimed by him that this apparatus develops a form of energy having a range of vibratory rates similar to the range of rates inherent in the different diseases of the body.

These are the basic claims made for E. R. A. From time to time Dr. Abrams and his co-workers have made other claims of a still more startling nature, such as determining the religion and nationality from the blood specimen; measuring, by means of ohmage readings, the distance between the blood specimen and the person from whom it was taken; the diagnosing of a patient by means of his photograph which is said to serve in place of the blood specimen, and the diagnosing of such psychological phenomena as love, fear, deception, and so on. Whether these additional claims are to be taken seriously or not, we do not know. Some of them have undoubtedly done untold harm to the E. R. A. cause, inasmuch as they have been turned into powerful ammunition by the attackers of this electronic technique. Indeed, we have been asked by some of the leading E. R. A. men not to take these additional claims seriously, inasmuch as they were merely experiments and mere diversions, engaged in by Dr. Abrams and his students in the San Francisco clinic, as an offset to the serious and rather tedious routine of diagnosing blood specimens hour after hour.

Now, when the SCIENTIFIC AMERICAN embarked on the difficult quest of investigating the validity of the claims of Dr. Abrams and the electronic technique as a whole, it was under the firm impression that the claims and the technique were definite and well established. For one thing, the Abrams method of diagnosing and treatment is being used every day of the year. Next, we had been given to understand that it took the place of orthodox medicine when the latter failed miserably. Then, too, many M. D. practitioners have taken it up, after becoming convinced of its merits. Again, we had undergone an electronic diagnosis, and had heard our state of health reviewed with cocksure definiteness and dispatch; it was this, that and the other thing, with so much of each. It was a matter of precision, so it seemed, as compared with the relative uncertainties of the usual orthodox diagnosis. We had no way of determining how accurate the diagnosis might be. We were informed, however, that the electronic diagnosis should run at least 75 per cent accurate, as compared with 40 per cent or less for the usual orthodox diagnosis. To which we can only add that these are not our figures, but those of the electronic reactions practitioners. And we are by no means obliged to accept them as final at this state of affairs.

Is it any wonder that the SCIENTIFIC AMERICAN felt that the basic claims of E. R. A. could be analyzed in short order? We were under the firm impression that any E. R. A. practitioner could give us a satisfactory demonstration, proving that the reactions took place in the delicate nerve centers of the human detector or reagent, and that these reactions, in connection with the diagnostic apparatus, could serve to identify unknown blood samples, germs, and other things. In one of our informal calls on E. R. A. men we noted that the practitioner made use of tiny vials which were said to contain diseased tissue and germ cultures. These vials served to check up on the accuracy of the diagnostic apparatus, the reactions of the reagent, and the skill of the diagnostician.

As a starting point, we invited electronic practitioners to cooperate with us; for we are investigating the electronic diagnosis and treatment technique as a whole, and not the individual practitioners. We have emphasized that point over and over again. Furthermore, in keeping with this policy, we have refrained from mentioning the names of those who cooperate with us, feeling that the purposes of our investigation are better served if no names are given. And in confirmation of the wisdom of this policy, several E. R. A. men have already voiced their approval.

It is but fair that we mention here that so far only one electronic practitioner has come forward and cooperated with us in a test. This practitioner, whom we have called Dr. X, underwent a test to diagnose the contents of unknown pure-culture vials. A formal report of this test appeared in our November issue, and the results were far from convincing.

Meanwhile, no further tests have been made, much to our disappointment. We have been promised tests and it does appear at this writing as though we shall have some real cooperation in the very near future. But from our first test to the present writing, little has been done except to listen to the criticisms of our first test on the one hand, and to reply to these criticisms by correspondence. The E. R. A. fraternity, which is rather numerous, has been devoting no little time and effort to arousing a storm of protest on behalf of the practitioners and their patients who claim to have received very definite benefits from E. R. A. One E. R. A. association even went so far as to send out a form letter to practitioners, urging them to ask their satisfied patients to write to us, protesting against our methods of investigation, assuring us of the wonderful merits of E. R. A., and urging us to be fairer and wiser in our selection of cooperators.

Unfortunately, we find it necessary, in view of the avalanche of mail that has poured into our office as the result of form letters, to enter into the personal side of an E. R. A. tangle, very much against our will. We were not very long at work on this Abrams matter when we discovered the dissensions in the electronic ranks. Externally, this new electronic technique appears to be one and indivisible, headed by Dr. Abrams. Internally, however, we discover that the electronic technique is being broken up into several variations, with more or less adherents for each variation. Thus there is the genuine E. R. A. technique, used in conjunction with apparatus approved by Dr. Abrams and manufactured by a laboratory in which Dr. Abrams is directly interested. Then there is what appears to be the E. R. A. technique, making use of non-Abrams apparatus which are referred to as "bootleg" apparatus in Dr. Abrams' own journal. Lastly, there are decidedly different electronic techniques which bear but a remote resemblance to the E. R. A., and which make use of as many different types of apparatus. And needless to say, there are as many shades of opinion as there are different techniques and apparatus, and each camp insists that it has the very last word in electronic diagnosis and treatment, and that all others are unscientific, inaccurate, and more or less worthless.

In explaining away the failure of Dr. X, the E. R. A. men have been rather unsportsman-like, to say the least. The main reason advanced for the failure of Dr. X to make good in our first test of electronic technique, is that he is not an E. R. A. man, and is therefore incompetent. We have been accused of intentionally going to a non-E. R. A. practitioner. Why go to a non-E. R. A. practitioner, who uses non-E. R. A. apparatus, when you pretend to be investigating Dr. Abrams? we have been asked.

Again we say, we are not interested in the personal side of this Abrams question. We are interested in the blood emanations, in the little rheostat switches, in the delicate nerves of the reagent, in the electronic reactions, and in other phases which, if they can be proved to be genuine, open an important field of research to the scientific world. We care nothing about the opinions which electronic practitioners bear toward one another, and we have not set up our committee as an examining board to pass on the training of the various E. R. A. practitioners.

As to whether Dr. X is a genuine E. R. A. practitioner, it is not for us to decide. We were under the impression when we undertook our test with Dr. X that he was a genuine E. R. A. practitioner. We believed that he was using the Abrams method. We saw the genuine Abrams apparatus in his laboratory, although for our tests he made use of other apparatus which he claimed was more accurate. We saw him using the Abrams "Atlas"—a loose-leaf book containing data regarding vibratory rates, percussing areas, and so on—in going about his work, when he found it necessary to diagnose for disease rates outside the usual routine.

In reply to Dr. Abrams' statement that Dr. X is not a genuine E. R. A. practitioner and is therefore unfit to cooperate with us in our investigation, we take this opportunity of stating that Dr. X has submitted documentary evidence which convinces us that (1) he was one of the original pioneer class that Dr. Abrams taught in 1913 and then again in 1914; (2) that he conducted an experimental station for several years to test out the teachings of Abrams; (3) that in the summer of 1922 he took up his third course in the Abrams technique, this time at the authorized college in Bradford, Pa., under Dr. J. W. King, the dean of that college; (4) that after he finished this last course, Dr. King ordered his diagnostic and treatment outfits directly from Dr. Abrams, all of which constitutes what is presumably necessary to become an E. R. A. practitioner. Furthermore, the documentary evidence indicates that Dr. X, not approving of the business methods which govern the rental and use of the genuine E. R. A. equipment, decided to use other machines and to retain his independence in developing electronic technique.

To quote Dr. X, with regard to this matter: "There can be no other reason than the fact that I am not using the machines designed by him that gives him the excuse to say that I do not represent the genuine E. R. A. methods. To say the least, I consider it most unkind and ungrateful of Dr. Abrams to make such a statement when he knows to the contrary, especially knowing as he does how, because of my unceasing devotion and loyalty to him and his work for the past ten years, I have suffered all any pioneer of a new innovation could suffer. Fighting as I still am for the same cause as he is, I am astonished also at the apparent total absence of wisdom on his part in putting obstacles in my way."

Having presented these facts, we shall dismiss the Dr. X and Dr. Abrams controversy, for nothing is to be served by our engaging in differences between electronic practitioners. We are still interested in those blood emanations and the delicate reactions and the rheostat switches, nothing else. Dr. X has taken exception to our printed statement regarding the "Typhoid Mary" case which he has been treating. An investigation of the various documents in this case reveals that we were substantially correct in our report of the facts, hence we do not find ourselves called upon to publish more about this matter which is rather irrelevant to the general question under discussion. Still one more point, Dr. X wishes to make it clear that he undertook the test as an experiment, because he had never before worked with pure germ cultures, and that he did not expect the test to be reported. We labored under the impression that we were making a definite test, rather than an experiment. If there has been any misunderstanding in this connection, we are very, very sorry.

Meanwhile, why all this fuss about Dr. X? The question is not so much whether Dr. X is a genuine E. R. A. or not, but whether pure germ cultures can be identified. Here we strike another of those controversial matters of which E. R. A. seems so prolific. We have been assured by some E. R. A. men that pure germ cultures can be definitely identified, and by others that they cannot. The preponderance of opinion seems to be that they cannot, and we are about ready to set down as our first finding that pure germ cultures cannot, at this state of the art, be identified by means of the electronic reactions diagnosis. Our first test pointed toward that decision, and the mere fact that no other electronic diagnostician has come forward to undertake the same test which Dr. X so willingly undertook, would serve to confirm it. One E. R. A. man in New York City has been working for several months with germ cultures, shielding them with lead foil and trying out various setups of apparatus, but at this writing his experiments have led to unsatisfactory results.

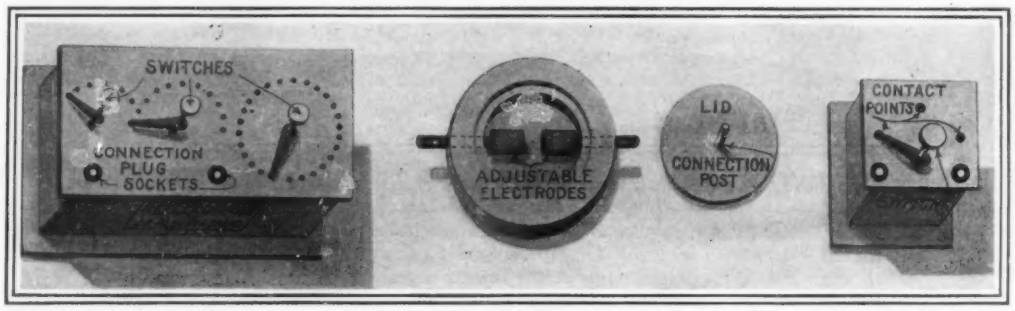
It is well to remember that we invite all electronic practitioners to cooperate with us. Time and again we are asked why we do not go to Dr. Abrams, inasmuch as he is the foremost exponent of the electronic technique and is best qualified to give us convincing proof. To which we hasten to add our full agreement with such views and suggestions. Our investigation was no sooner announced than Dr. Abrams wrote to us, offering to cooperate to the end that the truth might be made known to the scientific world. We have gladly accepted this cooperation and we certainly appreciate it. Through the kind offices of Dr. Abrams we have received numerous pieces of literature regarding this subject, which have served to give us a rather extensive background of knowledge so as better to direct our efforts.

The suggestion has been advanced that we should send a representative to the laboratory of Dr. Abrams in San Francisco. Truth to tell, Dr. Abrams himself suggested our sending a man to his laboratory. Were our investigation a mere matter of reporting interesting observations, the idea would be gladly carried out, for there would be no better story than that of Dr. Abrams at work. But inasmuch as this investigation is of a serious, scientific nature, aiming to arrive at the basic facts rather than to report mere impressions, we firmly believe that a visit to Dr. Abrams' laboratory is of secondary importance at this time. No doubt such a visit would serve to witness numerous startling demonstrations, but it is well to bear in mind that "demonstrations" do not count as evidence in a scientific investigation. Tests, conducted under test conditions, must constitute the necessary evidence on which a final and lasting verdict can be based.

Some time ago we were favored with a visit of Dr. Abrams' personal representative, during which the question of cooperation was discussed at length. We suggested a number of simple tests which might be conducted at this time with Dr. Abrams, such as the forwarding of blood specimens to San Francisco to be diagnosed for us. There are any number of blood tests which might be undertaken and which would disclose in short order the fundamental value of the electronic diagnosis. And then, day in and day out, Dr. Abrams is diagnosing blood specimens sent to him by his practitioners throughout the country.

Please note that we are as anxious that the tests be fair as are the electronic practitioners. We desire to obtain results. We have not the time to make tests

(*Continued on page 69*)



The Abrams Reflexophone, shown at the left, consists of a resistance box with three multi-point switches. The first switch introduces resistance in steps of ten ohms, the second introduces resistance in single ohms, and the third introduces resistance in 25ths of an ohm. The three switches or rheostats are connected in series. Usually three of the reflexophones are employed, as shown on the facing page. The center sketch shows the dynamizer, with its adjustable electrodes and lid. The electrodes are connected with the ground, while the lid connection goes to the rheostatic dynamizer. The right-hand sketch shows the rheostatic dynamizer, the function of which is to amplify the electronic energy

Three of the instruments employed in the electronic reactions of Abrams diagnosis

DOES a drop of human blood give off emanations such as are given off by radio-active substances? Can these emanations be gathered and tuned in by means of a bank of resistance coils in series, and led to the sensitive nerves of a healthy human being, where they cause certain changes or "reactions"? Are these reactions, assuming that they do take place, a reliable indication of the passage of the blood emanations through the resistance coils? Is it possible, by such means, to read the life history of a person like an open book, merely from a drop of blood? Has a new form of energy been discovered which contradicts established medical, electrical, and, in fact, general science as it exists today?

Seeking answers to these questions, the SCIENTIFIC AMERICAN *has undertaken an investigation of the Electronic Reactions of Abrams method of diagnosis and treatment. Positive proof of the validity of the claims made for this new technique is sought. The cooperation of everyone is invited, to the end that the truth may be learned and presented to the scientific world. Scientific accuracy demands that the proof be irrefutable, and to that end a number of tests are to be conducted for the purpose of obtaining positive evidence.*—THE EDITOR.

Traffic and the Law

The Unnecessary Divergence Between the Motor Codes and Customs of the Several States

By the Scientific American Staff

IT'S AN old, old story; but let's look at it again. There are 14 million automobiles and motor trucks in the United States. Just what does this mean to the man behind the wheel, trying to get from Here to There in the least time and with the most comfort?

All told, we have 2,800,000 miles of public roads. That makes five cars to every mile of road. But at least 90 per cent of the traffic is confined to 350,000 miles of paved road. For such highways the motor concentration jumps to 36 per mile. This would mean a spacing of 300 feet between vehicles; and if Mr. Average Driver maintains a 20-mile pace, he would pass an approaching car every five seconds. Cut the figures in half if you will, to take account of the fact that all the cars and trucks are never on the road at once; agree that the remaining estimate applies only to certain hours—the situation is still severe enough. The failure of the quoted average to be realized in ordinary open-road driving is met by its terrific inadequacy to represent the congestion of the city streets.

Such impressive averages make specific instances more or less superfluous. But the fact deserves mention that at the height of the Sunday evening crush, many of the leading highways entering New York City are filled with solid traffic lines for forty or even sixty miles out. Approaching the city from the west, one sometimes meets the standing ferry lines at a distance of four miles from the river. A parallel situation exists around all our big cities, while in their actual streets the jam at the busiest hours beggars description. At the main corner in Newark, and for six long and weary blocks through the heart of Los Angeles, *all* turning in or out of the main street, right-hand as well as left-hand, has had to be prohibited.

The problems arising out of this fearful volume of automobiles fall broadly into two categories. There is the issue of making the highways safe—an inordinate number of people, in and out of the offending vehicles, is killed every year through the agency of automobiles. And there is the issue of making the highways expeditious—it takes longer and costs more to move from point to point over our roads, than it should.

The problem of safety presents two major angles—the regulatory one and the physical one. On the broadest, flattest and straightest highway imaginable, with perfect pavement, accidents will occur in the absence of supervision of some sort. And on poorly paved roads, with narrow bridges, blind crossings, sharp corners and excessive grades, accidents will happen in spite of the most complete system of traffic rules and the most careful observation of the law. We must have safe highways, sanely used, before we shall bring down the accident total to the irreducible minimum.

In exactly the same fashion, the problem of making the use of the highways expeditious divides into two. In the absence of proper regulation of points where streams of traffic meet, or where congestion arises from other causes, or where the road hog is tempted to do his worst, we will necessarily have traffic tangles which cause annoyance and delay, regardless of how well our roads are laid out. And regardless of how well we regulate traffic at the critical points, if the physical relation between the highway, the railroad, the grades and turns, the cities and towns traversed, etc., etc., is not what it should be, we cannot keep the cars flowing smoothly and expeditiously.

In the present article, we shall have little to say of the physical problems of making the roads safe and making them swift, beyond this mere pointing out of the existence of the problem and its place in the general scheme of automotive philosophy. For, important as it is to have the physical characteristics of the roads correct, very many of the existing roads are wrong in numerous fundamentals. Very many existing laws are wrong too; but the changing of a law is, on the whole, a somewhat simpler, and certainly a less expensive, process than the changing of a much-used highway. So in this initial attack upon the traffic problem, we shall devote ourselves mainly to the discussion of automobile laws.

Here again the problem splits into two halves. The law deals with two classes of drivers. There is the man who is bent only on beating the game, who will violate all the laws with a light heart if he thinks he can get away with it, or if the penalty seems less than the immediate profit. The law must deal with the problem of catching, restraining and penalizing this irresponsible driver; and in dealing with him, harshness should be the keynote. On the other hand, by far the larger proportion of motorists come in contact with the law only in what should be its beneficent aspects. To them, the law need be only a set of agreed-upon principles for insuring that all of us drive to the least interference with any of us. It specifies certain equipment which we must carry, not with the view of forcing us to carry it, but in order that we may have a convenient and authoritative standard of reference. It prescribes the manner of our driving, in general and in particular circumstances, not with the idea that we need to have a club held over us, but again so that each of us may have a standard by which to forecast the probable conduct of the other fellow. In defining and enforcing these and other necessary standards, the law can afford to err on the side of lenience. It can often correct without penalizing, it can even more often impose a light penalty as a mere jog to the offender's memory, it can and should reserve the display of its teeth for the habitual or the wanton violator. Inasmuch as those whose contact with the law comes entirely in its regulatory aspect vastly outnumber those who face the judge for the purpose of being punished, we again make a reservation for future consideration. The punitive side of the statutes will be dismissed from the present article right here, and we shall center our attention upon the regulatory aspects of the laws, rules and customs that govern the movement of traffic over the open road and the city street.

THAT there exists a traffic problem, everybody who drives an automobile is well aware. Just what elements go to make up this problem is perhaps not so clear; just where to look for a solution is even less evident. The great danger seems to be that, before the problem is defined and the solution found, the ordinary growth of the industry will have carried the situation completely out of hand. The SCIENTIFIC AMERICAN *therefore proposes, during the coming year, to devote special attention to the attempt to reduce the traffic problem to its fundamentals and to strike upon the best means of relief; and the accompanying article, with its analysis of the possibilities, is the first gun in this campaign.*—THE EDITOR.

The combination of the ferry from which these cars have just come, and the grade crossing, is a very troublesome one. Out of the picture at the left is a line of cars many blocks long, waiting their turn to reach the boats

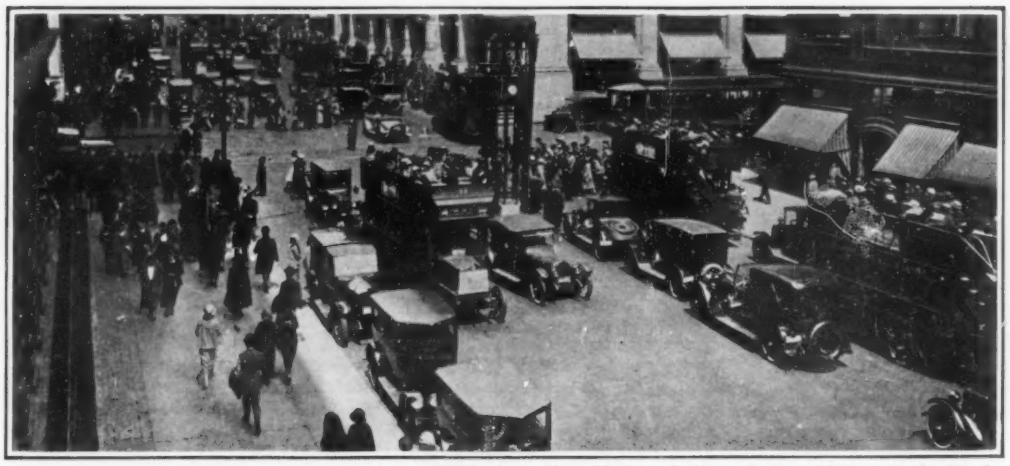
It is axiomatic that the safe use of the highways by all of us depends upon proper knowledge by all of us of these laws, rules and customs. One who insists upon keeping to the left will get smashed up; but with him he will smash somebody who was dutifully keeping to the right. Your ignorance of traffic laws exposes to danger perhaps scores of people on foot and in other cars, who had counted upon your doing the usual thing. It hurts you just as much to be hit through the other fellow's ignorance of what to do as though he had pursued you across the sidewalk and into a shop window with the deliberate intent of enrolling you on the list of the week's automobiling casualties.

There was a time when the ways and means of your acquaintance with the law were purely your concern and your responsibility. Fundamental in our jurisprudence is the principle that ignorance of the law is no excuse for its violation. The principle is a wise one, and in general it must prevail. But when the circumstances are such that your ignorance of the law may damage others as badly as it can damage you, it is time for the law to ask whether some degree of responsibility for general knowledge of the statutes does not devolve upon the community as a whole. In the case of the traffic laws the answer to this is an emphatic "Yes."

We have seen parked simultaneously about the public square of Mansfield, Ohio, cars from twelve states. On the day of the Dempsey-Carpentier fight, we drove westward over the Lincoln Highway from New York to Gettysburg; and we passed cars from every state east of the Mississippi (outside of New England), headed toward Jersey City. From every southern state with one exception we saw at least six; from Illinois more than we could conveniently count. The American autoist does his driving on the roads of many states. Can he be sufficiently well acquainted with the traffic laws and usages of the states and communities through which he passes, to avoid the constant hazard of arrest for petty violations, the occasional peril of a major transgression, and the certainty that some of his actions will embarrass or puzzle other drivers? If the laws of all states were sufficiently similar, he obviously could. Equally clear is it that the laws of the various states *could be* sufficiently diverse to render it quite impossible for him to meet this demand.

In point of fact, the existing diversity is sufficient to have been the subject of comment and complaint; but seldom if ever has a bill of particulars been offered. Suppose we attempt this on a modest scale. Our basis is the printed pamphlets in which 38 of the states publish their motor code. Alabama, Connecticut, Illinois, Michigan, Ohio, Oregon and South Carolina have failed to meet the request for such material; Arkansas, Oklahoma and West Virginia, asked for their motor codes, send only the laws that govern the financing, construction and maintenance of their highways. But the 38 which we are able to cite are ample to show the wide divergence that exists, and the impossibility of the tourist's having adequate knowledge of the motor laws of all the states which he traverses.

Twenty-six states make no demand upon the man at the wheel save that he have the price of a car—there doesn't appear to rest anywhere the obligation even to see that he learns to drive before he ventures on the public roads. Six states require a driver's license, issued originally after examination of some sort and renewed annually without further test. Two states issue licenses, but require merely the fee without any examination. One gives a permanent license after test. One licenses truck drivers after test and drivers of passenger cars without test. North Carolina leaves the licensing of drivers to local jurisdiction. New York requires examination and license from all residents of the metropolis, while up-state drivers go unsupervised. Practically all states license paid chauffeurs.



A glimpse of the traffic on a crowded street (Fifth Ave., New York). Before the installation of the block-signal system of control, conditions here were far worse than in the picture. Street congestion is probably the most costly aspect of the traffic problem today.

The lack of uniformity here is not so flagrant as in other instances which we shall cite. Broadly we may say that the state either licenses drivers, or does not license them; and that the question is of minor interest to the driver himself. It is of major interest to the state authorities, however. Failure to demand driving licenses makes it difficult to identify the driver personally, or to insure that he is authorized to drive the car in which he sits; it tends toward the presence on the roads of irresponsibles who could get a license with difficulty or not at all; and it robs the law of the very valuable penalty of license revocation. Further, it embarrasses the states that do require licenses, placing upon their roads unlicensed drivers from other states who have complied with their home laws and hence are entitled to reciprocal privileges, but who are impossible of identification and difficult to control.

Even where there exists no license requirement, it is a simple matter to make it specifically unlawful for certain classes of persons to operate a motor vehicle. All states make it a crime to operate a car while intoxicated, and practically all license states punish this offense with revocation. But when it comes to driving by children, the divergence is wide.

Three states bar driving by those below 14; four make the limit 15, nine 16, one 17 and one 18. Two others have age limits which apply only in incorporated towns. One restricts the age of paid chauffeurs only; another exempts from its age limit children who can prove their competence. Ten states make no provision whatever against driving by infants; five others have age limits, but invalidate them by permitting children to drive when accompanied by an adult. Kentucky alone puts this excellent idea to proper use, with a limit of 16 for children unaccompanied, and 14 accompanied. In fifteen states, it will be seen, a child of six may go on the public roads in charge of an automobile without violating any specific law.

Of course this is shocking on its merits; but it might appear that the lack of uniformity is of minor importance. Where it actually hurts is in its effect upon the extension of reciprocal privileges. Several years ago a New Jersey youth of 17 (just over the limit of his own state) was fined for driving in New York, where the limit is 18. The first motion on his behalf by the New Jersey Motor Vehicle Commission was rebuffed at Albany. Only a last-minute acceptance of arbitration by the New York Commissioner averted drastic retaliation, which would have taken the direction of minute enforcement of every letter of the Jersey law against New York cars, and would have amounted to a suspension of reciprocity. The difference between 17 and 18 years doesn't amount to much; but what about, say, Kansas with a 14-year limit and Nebraska with none? When a Nebraska child of eight drives across the state line, is he subject to arrest for his very serious violation of the Kansas law, or does the fact that he can drive legally at home entitle him to reciprocity? There is good law and good logic on both sides of this question; the only apparent way to settle it without any kick-back is for all states to have the same age limit. And why can't they do this? If it is safe for a 14-year-old to drive in Kansas, it is equally safe in New Jersey; if it is really improper for anybody short of 18 to drive in New York, it is equally improper elsewhere. Once granted a mechanism for reaching an agreement, there is no reason in the world why there should be more than one age limit for drivers in the entire United States. The difficulty, of course, lies in getting an initiative taken in such way as not to make any state legislature feel that it is being dictated to from abroad.

Suppose now we examine a point that interests the driver very directly. What do *you* do when you overtake a street car that is standing to receive and discharge passengers? If you are a native of Idaho, New Mexico, Pennsylvania, Utah, Vermont, Wisconsin or Wyoming, nothing is left to your imagination; you stop and wait for the trolley to move, unless there are safety zones. But if you carry this custom from one of these states into some of the others, you will get bawled out for obstructing traffic.

In Florida you may slip past the standing trolley at five miles per hour, in New Hampshire by exercising "due care," in Kentucky when you consider it safe to do so—not so idiotic as it sounds, since it puts the consequences right up to you. In Rhode Island the statute implies that you may sneak around the wrong way—a very unfortunate habit to take with you on tour, since many states penalize it drastically. In Indiana you may pass if you are able to do so at a distance of 20 feet; otherwise you stop six feet behind the standing car, thereby giving its alighting passengers a chance to dash across behind it and get struck by approaching traffic. Maine specifies eight feet beside or five feet behind the trolley. Massachusetts is content with eight feet at the side—you may try to shove the obstruction off the track from behind if you regard this as profitable. Minnesota requires ten feet at the side or the exercise of care, Nebraska eight feet and a "slow" passage. California specifies ten miles per hour and six feet from the car; Montana makes it six miles and eight feet. New Jersey makes the margin eight feet; but when there isn't space for this you may go around the wrong way by exercising "extreme caution." This makes you absolutely responsible; for if anything *could* happen, you weren't exercising extreme caution in essaying the left-hand passage. The other 18 states of our list make no provision to cover this point of driving etiquette, which means that the municipalities will supply the deficiency, leading to confusion within the state itself. New York City, for instance, has a law a little different from any we have quoted. It prohibits the automobile from approaching nearer than eight feet *in any direction;* and though it is plainly enough worded, 99 per cent of drivers have to have it pointed out by a policeman or a magistrate that this includes the rear of the car, and regulates the behavior of an auto that can't squeeze past and has to stop.

Now there is just one reason for regulating the relationship between a moving automobile and a standing trolley. It isn't done to be humorous, or to annoy the motorist; it is done to make it safe for people to board and leave the trolley. It is very obviously not the case that this end needs to be achieved by different means in every state. It is very obviously true that a convention which affords adequate protection to the passengers of the trolley in one locality will do so in other localities. There is absolutely no reason in the world why all the states could not have the same law on this point—except for the difficulty of deciding just where the uniform law is to originate. It is of course equally clear that this difficulty has been to date the dominating factor, and that it alone is responsible for the divergence that exists. To this point we shall return later.

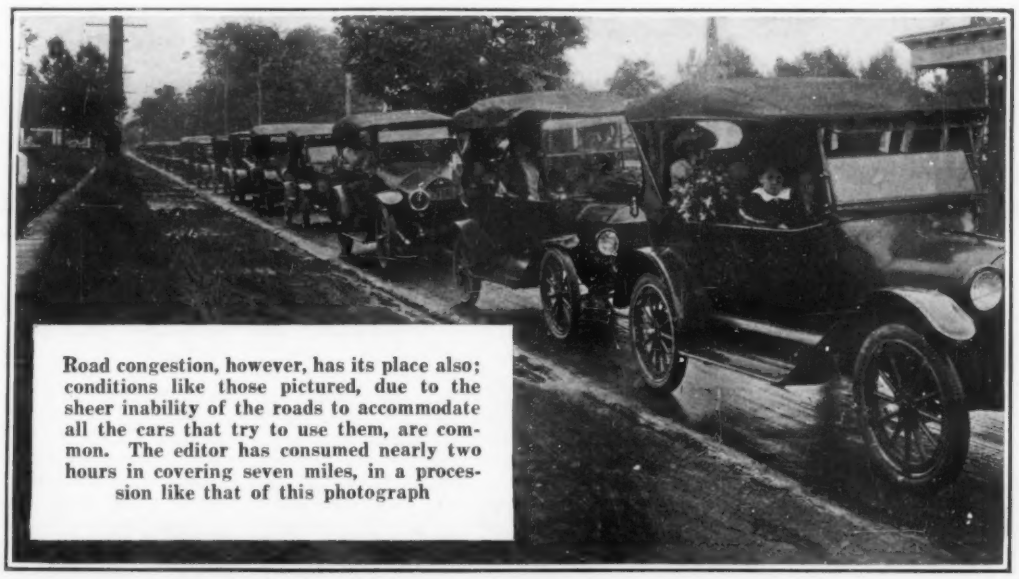
The speed limit is another very dreadful thing. Discrepancy here takes two directions. Every state, almost, has a general speed limit designed to apply on the open road; and lower limits designed to apply where traffic is heavy or the roadway dangerous. Divergence is to be found in the specific figure named for the maximum; and divergence is to be found, not alone in the specific lower figures named for special localities, but in the physical conditions which are laid down as defining these special-limit zones.

Let us look first at the matter of general limits. The states are about equally divided here on another matter of general principle. Some of them name a figure which is not to be exceeded under any circumstances. Others set, not an absolute speed limit, but a figure which may not be exceeded without establishing *prima facie* or presumptive evidence of reckless driving. If you drive faster than this and have a smash, it is more or less distinctly up to you to prove that you were not careless or reckless. In general, *prima facie* speed limits are a bit lower than absolute ones. Two states, Maine and Maryland, have both, and curiously enough agree on the figures; more than 25 miles per hour establishes *prima facie* evidence against the driver, and more than 35 is categorically prohibited. In all other states, the driver has to read the book, sometimes rather carefully, to discover whether the published speed limit is an absolute one or merely a suggestion for him to keep in mind in the presence of other cars.

As for the actual figures, five states specify 25 miles, sixteen name 30, and nine 35. As extremes, we have 20 in Massachusetts and 40 in Kansas. The Massachusetts limit, of course, is merely a presumptive one and is enforced with discretion; the writer has split it wide open in the presence of traffic officers without a reprimand. Three states ask for a "reasonable and proper" speed, without stating any numerical limits; and the pamphlet which Tennessee sends in response to a request for its traffic laws consists of a collection of isolated acts, none of which says a word about speed except the one that demands a full stop at grade crossings. Most drivers would probably agree that this increases the chance of stalling on the crossing, and is therefore an unwise provision.

There might be some argument that, for instance, a greater average speed is proper in Kansas than in

(*Continued on page 65*)



Road congestion, however, has its place also; conditions like those pictured, due to the sheer inability of the roads to accommodate all the cars that try to use them, are common. The editor has consumed nearly two hours in covering seven miles, in a procession like that of this photograph

Psychic Adventures at Home

An Episode that Started as Formal Investigation, Lapsing into Adventure and Actual Comedy

By J. Malcolm Bird

WHEN our psychic investigation was announced in our issue of January last, the first entry to come into our hands was that of Mrs. Elizabeth Allen Tomson, of Chicago. This entry was not forwarded by the medium herself; a lady whom we shall call Mrs. J. wrote on her behalf. The formal entry was followed by numerous letters, all expressing the medium's extreme desire to come before us at once, and all detailing the financial difficulties of the trip. The Chicago *Tribune* had indicated such interest in our psychic program that we passed the word to them, and they offered to finance and conduct the entire expedition. Miss Forbes of the *Tribune* staff had difficulty in getting to Mrs. Tomson, and more difficulty in getting her decision. It was finally pleaded that her daughter's health was such as to render the journey impossible at that time.

Mrs. J. was allowed by the Tomsons to remain in ignorance of all this; her first knowledge of the *Tribune* offer and its refusal came from me, accompanied by my sharp interrogation whether she was really the authorized manager for Mrs. Tomson, or just a volunteer. The question was answered in the former sense; but still I had no direct word from the medium. In the meantime, a very objectionable two-page spread appeared in certain Sunday newspapers in Chicago and other western cities. There were several weird daubs representing the artist's conception of ghosts and materializations; and the remaining space was filled by the statement, reiterated in various ways, that Mrs. Tomson was coming to New York to win our award. A few weeks later, a short news item ran through the press of the prairie states, to the effect that she had come, and had won it. That the Tomsons were in some way responsible for these stories seemed a natural assumption, and one which I tentatively advanced in correspondence. One of these letters was passed on to the medium's husband, Dr. C. H. Tomson; and as a result, I was for the first time honored by a communication direct from the Tomsons. This denied the charge which I had not made; and it repeated the tale of the ardent desire to come to New York, with the financial inability to do so. Several further letters from the Tomsons and from Mrs. J. followed, in much the same tenor. In the meantime, they had been able to finance trips to New Orleans and Kansas City, but not to New York.

Another phase of the matter has to do with the National Spiritualist Association. This body regards the medium as a fraud, and has so stated in public print. Great agitation was displayed by the medium's representatives lest we credit these charges, which they explained away at length, with free use of the word "persecution." In April, while I was in Chicago, Mrs. J. spoke the same piece over the telephone, and I had to interrupt her peremptorily to assure her that what other people thought about the medium would have no influence upon our Committee's deliberations. Our Judges were, however, necessarily aware personally of the fact that detailed charges of fraud had been brought against this medium at many times and places, so that there existed fair presumptive ground for inferring that many of her manifestations were fraudulent. Under all these circumstances, it was difficult to believe that Mrs. Tomson had any intention of appearing before us.

Late in October, nevertheless, letters came informing me that Dr. and Mrs. Tomson and their daughter were en route to New York. On Sunday, the 28th, they arrived. On Tuesday Dr. Tomson called on me and refused point blank to tell me where he was stopping. Throughout their stay in New York, my only means of communicating with them was to call Mrs. J. at her hotel. Usually she was out, and I could only leave a message for her to call me back. What I said to her she had to relay to the Tomsons with more or less difficulty, and she had to relay their answer. In the face of this, Dr. Tomson took every opportunity to impress upon me that Mrs. J. had no authority to arrange things for the medium, and that her presence constituted an intrusion into their affairs which was bitterly resented by them.

On Friday, November 2, I was informed by Dr. Tomson that the medium was to sit Sunday evening at the Raymond Hitchock estate on Long Island. I was invited to attend this affair, and to bring the entire Committee. Upon my explaining that Houdini was in Texas and that the two Boston members of the Committee had no present connection with the case, the invitation was turned into a peremptory demand that I secure the presence of the entire Committee. Dr. Prince and I actually attended, at much personal inconvenience; Dr. Carrington had a business engagement of the utmost importance and was unable to go. His absence created a fresh storm of protest.

This Great Neck seance had been announced to us, in the invitation, as an entirely informal one. The medium, we were told, before entering a series of serious sittings with a given circle, likes to meet the members in a friendly seance, for purposes of social contact. It was on this understanding that we went. From the moment when we entered the house, however, every effort was made to give our presence an official character. The "social contact" plea was a huge joke. The medium was held in seclusion in another part of the house. Our first glimpse of her was when she entered the cabinet, running through the circle at top speed to reach it; at the end she left it with equal speed and greater suddenness. Two frantic flights through the semi-darkened room were literally all we saw of her.

The cabinet was constructed after our arrival, under Dr. Prince's watchful eye. When all was ready, the room was far from dark, several of the windows remaining uncurtained. There was no moon, and no electric light outdoors within the range of these windows; but the night was clear, and after one's eyes were adjusted to it, the illumination from without was considerable. In addition, a single blue bulb was lighted in the room, across from the cabinet. The actinic value of blue light is so much higher than that of red that a stenographic record of the sitting could probably have been made. Yet, of course, the illumination was by no means sufficient to enable a close watch to be kept for suspicious movements.

Mrs. Tomson's act consists in the "materialization" of "spirit" forms. No definite claim is made regarding these. If one will, one is permitted to assume that some of them are "full materializations," in which the medium would be expected to be on her chair in the cabinet while the ghost walked. But they are freely admitted to be "usually mere transformations," in which the physical shell of the medium is used as the foundation for the building up of the presentment of some departed person.

Many instances are recorded when these figures have been "recognized" by sitters as those of their dead. The recognition applies particularly to the faces, which are usually covered by veiling or some undefined material, and revealed only gradually and in part. If the actual degree of likeness could be determined scientifically and given a numerical index, several possibilities might be examined. It might be judged that the manifestation was not objective at all: that the medium had got, telepathically or otherwise, a mental picture of the departed, which she had consciously or subconsciously imitated by normal physical means—a sort of animated or illustrated "spirit message." If the resemblance between the apparition and its original were high, it would be necessary to consider whether normal physical means could account for it, or whether on its face it were an objective phenomenon. The possibility would also be discussed that all the faces were but generalized types, and that chance plus hysteria plus desire would account for the recognitions.

Regardless of this interesting and difficult question, however, there is one outstanding feature of the apparitions which is distinctly an objective phenomenon—whether genuinely psychic, or fraudulent. Precautions are taken that the medium has with her in the cabinet no white material; and the spooks invariably appear clad in flowing robes of white. These white garments must be explained, on the one ground or the other.

At the Hitchcock seance, there were some thirty sitters—mostly theatrical people. In spite of the advertised informal character of the occasion, the presence of Dr. Charles M. Niesley of Manhasset had been secured for the purpose of subjecting the medium to anatomical examination. I am informed that Dr. Niesley is one of Long Island's best-regarded medical men. After he had finished his task, he turned the nude medium over to a committee of six ladies, who clothed her in a brilliant-hued kimono belonging to Mrs. Hitchcock. Clad only in this, they conducted her downstairs; and she rushed so precipitately through the circle and into the cabinet that I was barely able to gather the impression that in form and face she resembled her daughter closely.

Mr. John K. Brachvogel, a member of the law firm of Munn, Anderson & Munn, was present by agreement with me; and he had brought Mrs. Brachvogel. Much against her will, the Tomsons insisted that she serve on the committee of ladies; and, having got her on it, they attempted to make her participation stand as an official and binding act by the SCIENTIFIC AMERICAN.

The charge has, naturally, been made that the medium brings the white material into the cabinet concealed in one of her anatomical cavities; the medical examination is to insure against this. Dr. Niesley interpreted the problem as referring to the vagina alone, and directed his examination to that quarter only. He paid no attention to the rectum or the esophagus, and in fact had no instruments with him for so doing. Though he made clear the limitations of his work, Dr. Tomson exhausted every device to get from him a blanket statement that the medium could not possibly have anything concealed anywhere upon or within her; and similarly he struggled hard to make it appear that the SCIENTIFIC AMERICAN was a participant in Dr. Niesley's findings and was bound by them. When confronted at a later date with the suggestion that the medium might have carried material into the cabinet in a capsule of some sort in the rectum, the esophagus or the stomach, Dr. Tomson attempted to assert on his own authority as a medical man that this was an anatomical impossibility. The sword-swallower and the ruminant are sufficient to enable any laymen to contradict this claim.

Dr. Niesley examined the medium's hair. Mrs. Tomson, after he had left the room, informed the ladies that he hadn't done so and got them to do it again. She may have made an honest mistake; but the fact that she went to the trouble of making such a false statement and getting this test repeated lends to the suggestion that on putting her hair up for the second time she concealed something in it, more plausibility than it would otherwise have. None of the ladies was prepared to deny categorically that she could have done this.

If not actually taken into the cabinet within the medium, the white goods might have been passed to her, or planted in the cabinet. The cabinet finished, all sitters were invited to examine it; several did so, including myself. Then we were seated, the lights arranged, and we inferred that the medium was to appear. Instead of this, Dr. Niesley first and then the ladies were designated and sent upstairs to do their work. During the ensuing interval of twenty minutes the seated group broke up, and had to be reassembled when the medium was really ready to appear. I could not testify that the cabinet was not tampered with in this interval, nor could I find anybody else who could. Dr.

EVERY medium must decide for herself whether she cares to participate in our psychic investigation. She must consider our motives, the propriety and fairness of our undertaking, the feasibility of our conditions, and numerous other points. If on any grounds she decides not to work with us, our efforts to persuade a change of mind are kept within appropriate limits, both in degree and in kind. It is not our desire to harass any medium. But all data necessary for the choice between participation and non-participation are easily available, so that a performance like that of Mrs. Tomson indicates on its face that we are being trifled with. On account of its interest we have decided to tell the accompanying story. Because it is one that revolves about the personality of the medium and that of her husband, we tell it as a tale of psychic adventure rather than of formal investigation. Because in this instance it IS an essential part of the story, we are NOT withholding the identity of the medium.—THE EDITOR.

and Miss Tomson moved freely about during this highly artificial intermission. The procedure seemed sufficiently oblique to create active suspicion, which would be contradicted by no known facts.

When the medium made her dash for the cabinet, she actually brushed against her daughter; and the illumination was not such as to enable any sitter to acquit them of the possibility that something had been skillfully passed. In leaving the cabinet at the end of the sitting, Mrs. Tomson without the slightest warning burst through the curtains like a firecracker; and the daughter leaped up and caught her mother in her arms, supporting her through the group of sitters. The conditions to make possible the act of passing a guilty bundle back to the young lady were here present to an alarming degree.

With the medium in the cabinet, the sitting opened. Dr. Tomson and the daughter now made great show of not approaching the cabinet until after the first apparition had appeared. After a brief wait, the curtains parted, and a white-clad figure stood in the opening for a moment. Then the seance routine commenced.

This routine involves the idea that each apparition is directed at an individual sitter. No announcement of his identity is made; the doctor or the daughter gets a sort of "hunch" as to who is wanted next, picks this sitter out of the crowd, takes him by both hands to guard against any deliberate or emotional "rough stuff," and conducts him right into the very jaws of the cabinet. These roll apart, and the apparition is there. After a moment's inspection, the sitter is backed off a little by his conductor, and the apparition follows, thereafter retreating into the cabinet.

At Great Neck there were two recognitions. Mr. Hitchcock recognized an uncle, or a grandfather, or perhaps both, with heavily bearded face. One of the ladies, who stated that she had never met the medium or been interested in spiritism, was reduced to a condition of emotional crisis by her very positive recognition of her mother's face and voice (in the four words "My own darling child!"). This lady was embraced and kissed by her apparition, and several other sitters were touched by fingers or drapery.

In two trips to the cabinet I was not touched. The first time, the figure was heavily veiled, and Miss Tomson tried to convince me that there was ectoplasm in active movement upon the face. Finally the veil dropped suddenly; and though the head then rolled violently backward and the curtains closed quickly, I was positive that the face was the medium's. Even so, of course, no damage would be done her claims. On my second advance, the face that was presented had a curious unfinished appearance, as though the features were but half formed. The figure on this occasion avoided close inspection so that I could not check this impression.

So far as I could see, none of the figures was notably different in height or girth from that of the medium. At one point there were several words of good evening addressed specifically to me from the cabinet, in a heavy bass voice. Though this impressed me as obviously artificial, Dr. Tomson insisted that it was the voice of his father-in-law. The opening was not pursued.

Apparently the only avenue of attack for one seeking to demonstrate the character of these manifestations lies in consideration of the white drapery. The consensus was that this was a textile fabric —tulle was the word most often used in simile. In the advance notices which were given us of the performance, emphasis was placed heavily upon the unwrinkled appearance of the robes, and the extent to which the edges stood out crisp and unfolded. All this was exaggerated; I thought the substance could easily have been a fabric sufficiently light and soft to stand up, under close packing, well enough to account for its appearance.

Mrs. Brachvogel was quite certain, from the way the robes hung, that we were dealing with a made garment, and not with mere yardage of loose cloth. Incidentally, the yardage necessary to produce what we saw was again grossly overestimated in the extravagant advance statements. Likewise we were given to anticipate a fluidity and freedom of the white material (suggesting of course that it was ectoplasm) which the performance did not achieve.

Psychic supporters would accept no adverse verdict based upon capture and analysis of a bit of this material. Even if it were identifiable as the product of a given mill, the believer would accept it as an apport, brought to the cabinet from a distance, by psychic power, for the medium's use. For a scientific disposal of the case, the question how it got into the cabinet would have to be discussed from every angle. So far as the Great Neck sitting goes, conditions were too loose to permit the exclusion of obvious possibilities. It is of interest to record, however, that no sitter outside the medium's party was prepared to discuss the manifestations from any other angle than to ask "Where did she carry that stuff?"

On Friday, November 9th, the Tomsons gave a public seance at a spiritist church in Brooklyn. They had already attempted such a performance on Tuesday the 6th, but the doctor demanded that the collection precede the seance, while the church people insisted that the seance precede the collection. The net result was no seance—and no collection! The people who arranged the Friday sitting were sincere spiritists, who, nevertheless, believed that this particular medium was a fraud; and they planned to expose her at all costs. The climax came when one young man with an Irish surname, confronted with a ghost and finding his hands securely held, reached forward and bit the apparition! The sitting at once broke up in a free fight; although Mrs. Tomson postponed the faint, with which she usually meets rough tactics, until she was safely upstairs. The biter stated that he got a mouthful of cheesecloth.

Lots of well meaning folk are always trying to tell *us* how to catch our mediums red-handed. The general idea seems to be that one needs only to flash a bright light, or start a rough-house of some sort. Without any criticism of those who do it this way, we do it differently. We do not start with the assumption that the medium is a crook, but rather with the assumption that if he is one, the instrumental tests which would give us the necessary information about genuine phenomena will do as well with fraudulent ones. The precipitate people who see, in the imagined success of biting, grabbing, etc., a condemnation of our slower methods, or even of our willingness to sit with a medium who, if a fraud, could be caught by this rough stuff, miss the point entirely. At the same time, we are the last people in the world to deny that there is a certain delicious humor in the idea of biting a ghost, and finding that its precious ectoplasm is merely a mouthful of cheesecloth.

Our first test seance with Mrs. Tomson, in which we hoped to advance toward knowledge of the source as well as the nature of the white robes, was scheduled for Wednesday evening, November 7th. As usual, we planned to sit in the law library of Munn, Anderson & Munn. This room is carpeted; completely shelved for and lined with books, wherever door and windows permit; rather handsomely furnished—altogether comfortable and cozy. Numerous authorities and several mediums have seen it, and none has suggested that it was not a good place for psychic work. Mrs. J. herself was enthusiastic regarding its advantages.

Shortly after noon on Wednesday, Dr. Tomson called upon me, accompanied as always by his chauffeur. Whether he regards this man as a bodyguard or a witness I do not know, but I have yet to see him without him. He asked to see the room where we were to sit. He wasn't fairly over the door-sill, and had not looked at the room at all, before he stated in so many words that it would never, never do.

The only reason which he could present immediately in response to my query was that there were no facilities for disrobing the medium. I showed him there was a comfortable dressing room with running water, two steps across the hall. So he shifted his ground, and made the less easily controverted statement that the library lacked the psychic atmosphere.

Pressed to be more specific, he asserted that the room gave the impression of a public rather than a private place. I feel strongly that the reverse is the truth; but I merely reminded him that the medium has sat often and successfully in theaters and pulpits, and asked him in what way these places had an atmosphere of privacy which our library lacked. He explained that the difference lay in the circumstance that in the theater or the church *the audience was remote.* I was quite ready to grant that, for this medium, this was an important consideration, but I was surprised to have her husband urge it. I pointed out, not the suspicious character of the claim, but merely the obvious inconsistency—that such remoteness surely increased rather than decreased the resemblance to a public place.

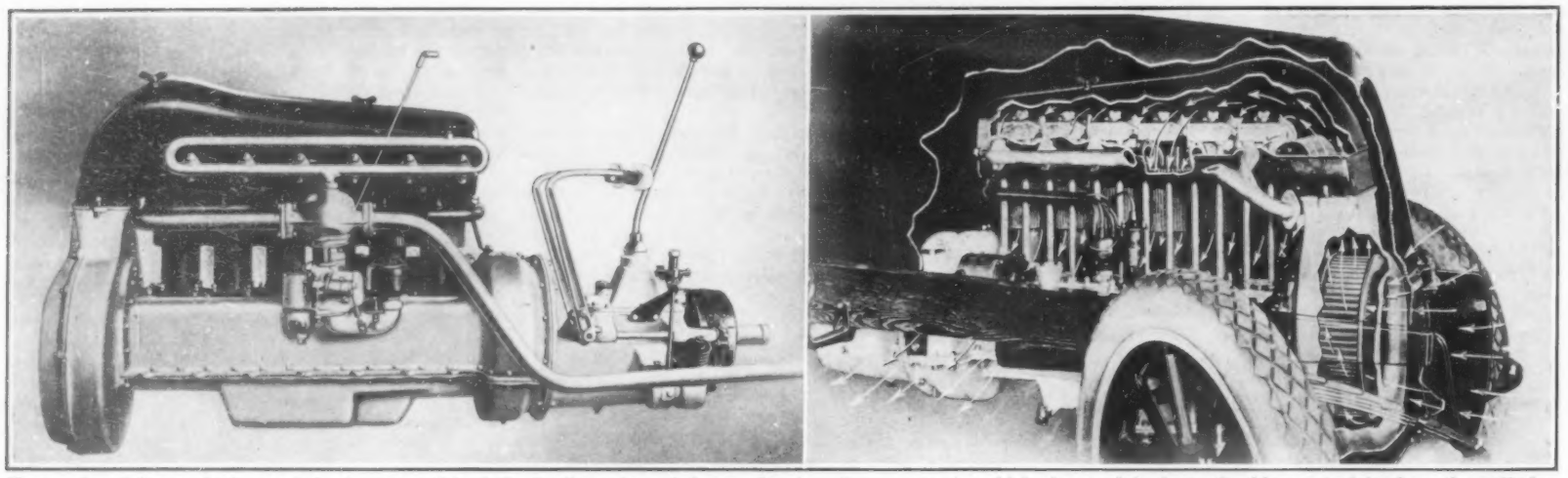
The doctor stuck to his guns, and ultimately asked whether we could not go out, to sit in a room in a private residence somewhere. I replied that on general principles we perhaps could, but that on eight hours' notice we couldn't. There would be, not alone the physical problems of the last-minute shift, but also the finding a place—not everybody wants a seance held in his living room. The doctor very kindly offered to take this load off my shoulders; Mme. So-and-So, a friend of his, he was sure would offer a room in her apartment.

No, I didn't laugh in his face. I pointed out, gently but firmly, that if our investigators were to place themselves in a position where they might have to render a favorable verdict, this must be of such character that our readers could accept it; and that they certainly couldn't accept it if we told them that we had sat in premises over which we had no control. This brought up the whole question of the propriety of our conditions, and even of the propriety of our imposing any conditions at all. We had announced that, if the conditions which we proposed to any medium were, in her judgment, inhibitive of the phenomena, we should be willing to discuss the possibility of attaining, in some other way, the end at which the offending conditions were aimed. Dr. Tomson tried to interpret this as obligating us to concede any demand which he might make for the abatement of conditions which he didn't like. The further he went the more absurd he got, until finally he was talking about supplementing our judges with three of his own choice! I finally reminded him that we weren't submitting ourselves to his test, he was submitting to ours; that if he didn't like our rules he needn't play the game at all, but that if he wanted to play with us, we were the rule-makers. He thought this horribly unfair and one-sided. He finally delivered his ultimatum; they would sit on premises selected by them, or not at all. So I called up my committeemen and my sitters and told them it was all off.

Thursday noon he ran in again—still with the chauffeur. He apparently thought I had been bluffing, and would recede. He asked whether we were prepared to sit outside our offices. No proposition to sit that day being involved, I indicated our willingness to hold the seances in the apartment of Mr. Orson Munn. Even this concession wasn't enough; he made the specific point, in so many words, that the medium would sit only in a place where we could have no preliminary control of the premises. I accused him of concealing his real objections to our law library, and told him that in my judgment he was afraid of apparatus which he pictured as concealed in the walls and floor, behind the books, etc. He wouldn't deny this charge.

As before, he carried the discussion afield. He made it very clear that they proposed to give us one sitting, and to demand a verdict on that slender basis. He referred several times to the Great Neck sitting as an opportunity which we had already had to examine the phenomena, and expressed anew his indignation that our entire committee hadn't been present. Yes, he had read our conditions, but, of course, in the case of a medium so well and favorably known as Mrs. Tomson we must be prepared to waive these! As a matter of fact, Mrs. Tomson was pretty tired of these alleged scientific investigations and these physical examinations, and she was not at all sure that she wanted any more of them. I asked him why they had entered our investigation if they felt that way about it, and he said that they never had entered it. I asked him what he was doing in my office, in that event; and he didn't seem to know, exactly. He finally realized that we were going to run our own investigation in our own way, and that we didn't greatly care whether he and his "medium" worked with us, or not. So then he went away, with a parting shot to the effect that we were being financed by the Catholic Church, and that our whole investigation was a fraud, designed to discredit innocent mediums. My parting shot was that I didn't believe he had at any time had any intent of sitting with us. Aside from these minor items, we agreed perfectly upon all points.

THE SCIENTIFIC AMERICAN *has undertaken an investigation of psychic phenomena of objective character, aimed primarily at deciding whether such phenomena occur, and secondarily at learning their cause if they do occur. The manifold subjective manifestations of psychism are for the present excluded from our investigation, because we are prepared to admit that they occur. We have invited all physical mediums to work with our Committee of Judges, who, as we have emphasized, are examining phenomena and not mediums. Less as an inducement to the medium, than to assure the public of the reliability of any favorable verdict which we may be called upon to render, we have offered $2,500 to the first medium who is successful in the production of psychic manifestations of a physical character before our Committee and under their test conditions. An outline of the proposed conditions, the membership of the Committee, etc., etc., will be found in our issue of January, 1923.*—THE EDITOR.



External and internal views of the latest model of the leading air-cooled car, showing the manner in which the conduit from the blower is joined to the cylinder assembly, the path of the cooling air, etc.

The Future of the Air-Cooled Car

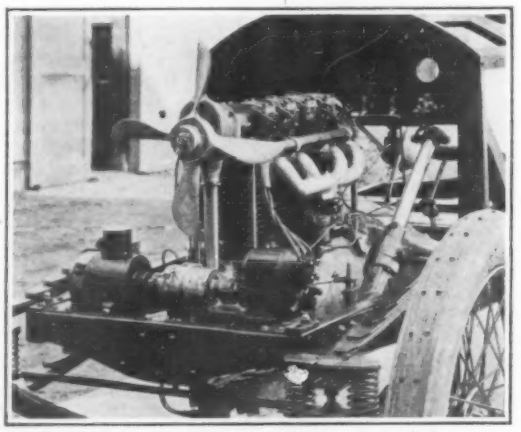
Engineering and Operating Facts that Call for Its Most Serious Consideration

By Victor W. Pagé, M.S.A.E.

THE thermal efficiency of any form of heat engine is determined by the ratio of the power obtained to a definite fuel consumption. A certain amount of energy will be liberated in the form of heat when a pound of any fuel is burned. If the greater proportion of the heat units derived by burning the explosive mixture could be utilized in doing useful work the efficiency of the gasoline engine would be greater than that of any other form of energizing power. There is a great loss of heat from various causes, among which can be cited the reduction of pressure of the expanded gas through cooling the motor and the loss of heat through the exhaust valves when the burnt gases are expelled from the cylinder. These losses vary in different designs; some of them can hardly be reduced, others can be changed by altering details of design.

The loss through the water jacket of the average automobile power plant exceeds 33⅓ per cent of the total fuel efficiency. This means that in most cases, more than one-third of the heat units that should be available for power are absorbed and dissipated by the cooling water. Another third is lost through the exhaust valves, leaving but 33⅓ per cent of the heat units available to overcome motor friction and do useful work. A great loss of heat through the cooling systems cannot be avoided, as some method must be provided to keep the temperature of the engine within proper bounds. However, cooling any engine is not a problem in refrigeration and the term must be used advisedly. It is apparent that the rapid combustion and continued series of explosions by which the engine develops its power would soon heat the metal portions of the combustion chamber and valves to a red heat if some means were not taken to conduct much of this heat away. The high temperature of the parts of an uncooled engine would burn the lubricating oil, even that of the best quality and whether of mineral or organic origin; and the piston and rings would heat and expand to such a degree, especially when deprived of oil, that they would stick and work hard in the cylinder. This would score the walls, and the excessive friction which then ensued would tend to bind the parts so tightly that the piston would ultimately seize, bearings would be burned out, the valves would warp, and the engine would soon become inoperative. Some owners of water-cooled cars who neglected to fill the radiator will recall some of the troubles mentioned to their sorrow.

The best temperature to secure efficient operation is a question on which considerable difference of opinion exists among engineers. That the efficiency of an engine is dependent upon the ratio of heat converted into useful work compared to that generated by the explosion or rapid burning of the gas is an accepted fact. It is very important that the engine should not get too hot, and at the other hand it is equally vital that the cylinder be not robbed of too much heat. The object of cylinder cooling is to keep the temperature of the cylinder below the danger point so the oil will not become unduly heated and thinned, but at the same time to have it as high as possible to secure maximum power from the gas burned. Air-cooled engines can be operated successfully at temperatures higher than the boiling point of water, which limits water-cooling.

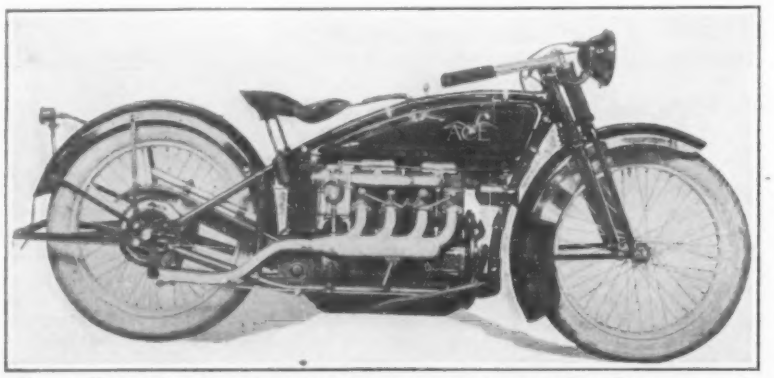


Typical power plant of a light, air-cooled car

There are two general systems of engine cooling in common use, that in which water is heated by the absorption of heat from the engine and then cooled by air passing through a radiator, and the other method in which the air is directed on to the cylinder and head, which must be increased in external area, and absorbs the heat directly instead of through the medium of water. When the liquid is employed in cooling it is circulated through jackets which surround the cylinder and head castings and the water may be kept in motion by two methods. The one generally favored is to use a positive circulating pump of some form which is driven by the engine to keep the water in motion. The other system is to utilize a natural principle that heated water is lighter than cold liquid and that it will tend to rise to the top of the cylinder when it becomes heated to the proper temperature, cooled water from the radiator taking its place at the bottom of the water jacket. A new development being experimented with is steam cooling, in which water vapor is used instead of the liquid.

Air-cooling may be by radiation or convection. In the former case, which applies only when small stationary engines are used and then but seldom, the effective outer surface of the cylinder is increased by the addition of flanges or spines cast thereon, and the air is depended on to rise from the cylinder as heated and be replaced by cooler air, this producing a natural but sluggish circulation. When a positive air draught is directed against the cylinders by means of a mechanically-operated fan, cooling is both by radiation and convection, which means air in motion. In latest types of engine the air draught may be directed against the cylinder walls by some form of jacket which confines all of the air current to the heated portions of the cylinder, which it passes at fairly high speed.

The earliest known method of cooling the cylinder of gas engines was by means of a current of air passed through a jacket which confined it close to the plain or unfinned cylinder walls. The gasoline engine of that time was not as efficient, being much cruder in all details, when compared to the later forms, and other conditions which materialized made it desirable to cool the engine by water. Even though gasoline design and materials used in their construction became more and more perfected, there has always existed a prejudice against air-cooling, though many forms of engines have been used, both in stationary and automobile, as well as in motorcycle and aircraft applications where the air-cooling method has proven to be very successful and practical. This prejudice on the part of the layman is accounted for largely, in the writer's opinion, by the preponderance of automobiles sold in which water-cooling is used exclusively.



Four-cylindered motorcycle cooled by current of air created by the passage of the machine through the atmosphere

The simplest system of air-cooling is that in which the cylinders are provided with a series of flanges which increase the effective radiating surface against which an air current from a fan is directed to absorb the heat. This increase in the available radiating surface of an air-cooled cylinder is necessary because air does not absorb heat as readily as water, and, therefore, more surface must be provided in order that the excess heat be absorbed sufficiently fast to prevent overheating. Air-cooling systems are based on

a law formulated first by Newton; the rate for cooling for a body in a uniform current of air is directly proportional to the speed of the air current and the amount of radiating surface exposed to the cooling effect.

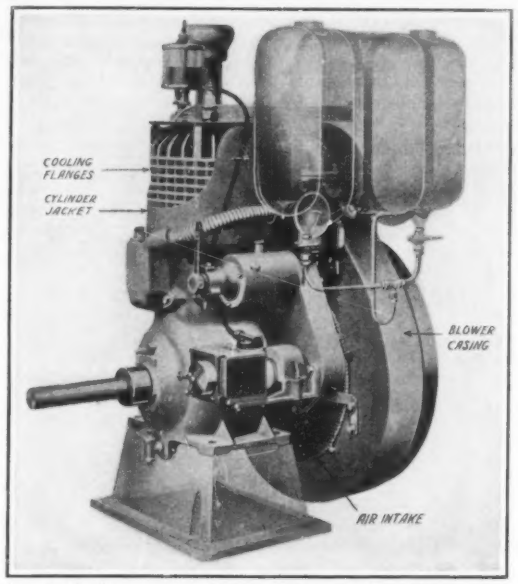
There are certain considerations which must be taken into account in designing an efficient and satisfactory air-cooled engine, which are sometimes overlooked in those forms cooled by water. Large valves must be provided to insure rapid expulsion of the flaming exhaust gas and also to admit promptly the fresh cool mixture from the carburetor. The valves of air-cooled engines are usually placed in the cylinder head in order to eliminate any pockets or sharp angled passages which would impede the flow of gas or retain some of the products of combustion and their heat, and new steels are used, which will not warp. When high power is desired, multiple-cylinder engines should be used, as there is a certain limit to the size of a successful air-cooled cylinder when used in automobiles, it being unwise to use cylinders larger than five inches bore. Much better results are secured from those having small cubical contents because the heat from small quantities of gas will be more quickly carried off than from greater amounts. All successful engines of the automobile type which have been air-cooled have been of the multiple-cylinder type and the use of single cylinders is confined to power plants of less than five horsepower, such as used in motorcycle construction or small stationary engines of not more than three to five horsepower.

An air-cooled engine of the simple or fan-cooled type must be placed in a chassis in such a way that there will be a positive circulation of air around it all the time that it is in operation. This air current may be produced by a fan or blower at the front end of the motor; by natural draught when a car is in motion as in the Rover, a small English car; or by a suction or blower fan in the fly wheel, the best exponent of which was the Franklin car prior to 1922. Greater care is required in lubrication of the air-cooled automobile engine cylinders and only the best quality of mineral oil should be used to insure satisfactory oiling. The oil must be viscous and heavy bodied because it is thinned down by the temperature of the parts. Castor oil is used in airplane engines of the air-cooled type, especially the revolving cylinder, fixed-crank types such as the LeRhone or Gnome.

The combustion chambers must be proportioned so that distribution of metal as regards its thickness is as uniform as possible in order to prevent uneven expansion during increase in temperature and uneven contraction when the cylinder is cooled. It is essential that the inside walls of the combustion chamber be as smooth as possible because any sharp angle or projection may absorb sufficient heat to remain incandescent and cause trouble by igniting the mixture before the proper time. The best grades of cast iron should be used in the cylinder and piston and the machine work must be done very accurately so the piston will operate with minimum friction in the cylinder. Airplane engines sometimes have aluminum cylinders with steel liners, but this is expensive construction.

One of the important considerations in connection with air-cooling of engines having more than three-inch bore is that the air blast must be confined as close to the cylinders as possible, and that a more energetic flow of air is needed than with water-cooling systems. The ordinary form of sheet-metal-blade fan is considered entirely adequate for water-cooled engines, but most engineers who favor air-cooling at the present time use fans of the airplane-propeller or blower type, which will furnish larger quantities of air than the simple fan would and which also direct it to the cylinders in a positive manner by enclosing them in air jackets which are attached to a manifold member running over them to which the discharge opening of the blower is coupled. The shape of the conduit is determined by careful computation and experiment to secure a smooth air flow.

Two engines by the same maker, one of relatively modern development, which utilize positive air-cooling methods, can now be described. The system of cooling is practically the same in both instances, except in the methods employed of creating the air blast. In the early Franklin system the cylinders are provided with vertical ribs, or flanges, and are encased by jackets which form part of a sheet-metal casing that covers the entire portion of the power plant. The fly wheel is provided with a series of curved blower-blades around its periphery and as it turns, it creates a partial vacuum in the compartment formed by the motor-base casing and the air-tight



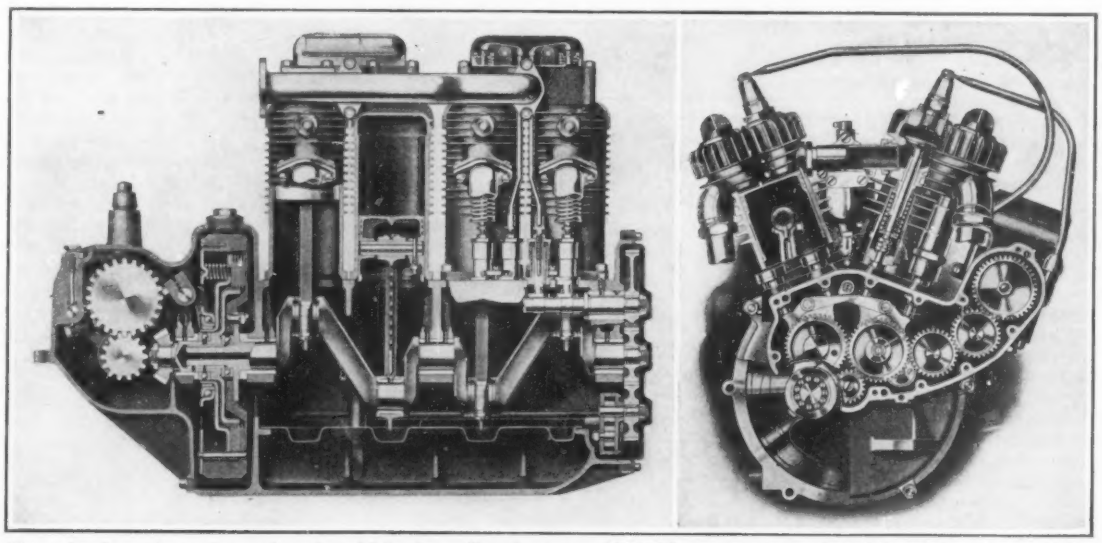
A relatively new stationary air-cooled engine using blower to create a blast

underpan. The strong suction effect draws air in from the front end of the bonnet and down through the cylinder jackets. The air currents pass over and between the flanges at fairly high velocity, and as there is a large amount of exposed surface, the excess heat is promptly disposed of and absorbed by air passing around the cylinders, which is ejected from the motor-base compartment by the action of the blower fly wheel. As the fan is part of the balance member which is attached to and driven directly from the engine crankshaft, there can be no failure of the driving means; and a positive air draught must be induced around the cylinders as soon as the motor is started. The velocity of the air currents increase directly as the motor speed augments, and positive cooling is obtained under all conditions. This system was used very successfully for a period of many years and is unchanged in essentials even at the present day.

In the cooling system which was used in the Frayer-Miller engines nearly twenty years ago, also in the Renault air-cooled aviation motor and which in improved form is shown in detail in the illustration of the latest Franklin engine, the method of cooling is different in detail but practically the same in principle as that previously described. An air blower is mounted at the front end of the motor and the strong current of air it produces is conveyed to an air conduit at the top of the cylinders, to which are attached the jackets surrounding the cylinder walls. The cylinder heads are only plain castings without ribs but the cylinder-wall area is increased by using a large number of steel flanges which are cast integrally with the cylinder. The air blower forces a blast of air into the air conduit above the cylinders at considerable pressure, and the only way it can escape is by passing around the heated portion of the cylinder head and cylinder before it is discharged through the bottom of the air jacket. As the blower speed increases with engine speed the value of the air current becomes greater when an augmented cooling effect is desired. The blower handles cold air, whereas the suction fly wheel had to handle heated air. A given amount or weight of air occupies less volume when cold than when heated so the blower to move cool air can be smaller and consume less power than the larger-capacity blower needed when it is incorporated in the fly wheel and must draw out warm air. It is mainly for this reason that the new Franklin system is stated to be an improvement over that used so successfully over a long period of years.

The flanges are not always of steel or cast iron, one prominent motor car manufacturer announced last year a motor in which copper flanges were intimately bonded with the steel cylinder wall by new brazing system. As copper carriers heat away about three times as fast as steel or cast iron, its use is an improvement. Aluminum flanges and cylinder, with a steel or cast iron liner for the piston to bear against, have also been tried; but extremely accurate and expensive manufacture and careful proportioning of parts are called for so that the cylinder and liner will expand together. The cast-iron cylinder with integrally cast flanges is practical and the cheapest construction.

Among the advantages stated for air cooling by its adherents, the greatest is the elimination of cooling water, which is a factor of great moment. In the temperate zone, where the majority of automobiles are used, the weather conditions often change in a very few weeks from the warm summer to the extreme cold of winter and sometimes one has these variations take place in a few hours. When water-cooled systems are employed it is necessary to add some chemical substance to the water to prevent it from freezing. The substances commonly employed are glycerine, wood alcohol, or a saturated solution of calcium chloride. Alcohol has the disadvantage that it vaporizes readily and must be often renewed. Glycerine is said to affect the rubber hose, while the calcium chloride solution crystallizes and deposits salt in the radiator and water pipes. Then there are the troubles incidental to leaky pipes, pump and radiator, failure of pump, clogging or rupture of rubber hose and other difficulties.



Two simple motorcycle engines in which air-cooling is accomplished by currents produced by the passage of the cycle through the air, without the use of any blower

Obviously the elimination of water and the use of a well designed air-cooling scheme will provide a system that should be fully as effective during the extreme cold weather as it is during the more favorable summer season. It would seem that air-cooling methods could be applied to advantage in the future, more than in the past, to commercial-vehicle power plants which must be capable of efficient service under widely varying conditions. One of the disadvantages of the air-cooling method, as stated by those who do not favor this system, is that engines cooled by air cannot be operated for extended periods under overloads or at very high speed without heating up to such a point that premature ignition may result. Experience has shown that this objection cannot be raised against the blower-cooled engines. The water-cooling systems, so it is claimed, maintain the temperature of the engine more nearly constant than is possible with an air-cooled motor, and an engine cooled by water can be operated under conditions of inferior lubrication, inaccurate valve

(*Continued on page 71*)

Floating the Car on Oil

Little Known Facts About Automobile Lubrication and What It Means in Terms of Wear and Tear

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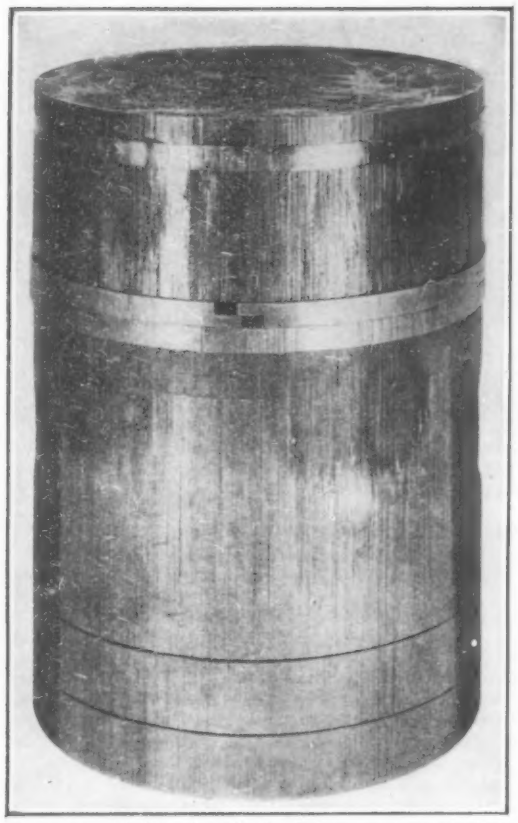


Excessive "choking" of fuel mixture was responsible for the scoring of this piston. Spots around two small oil drainage holes indicate that dilution or "cutting" of oil was complete

IN lubricating by means of oil, we simply supply a very large number of minute ball-bearings between two surfaces. These balls are little particles of oil, and the more viscous the oil, the harder it is to break them up. The art of lubrication is the art of getting the right amount of oil in the right place at the right time. In the modern automobile, this is pretty well provided for by numerous patented devices, and so it has come down to the human factor—that is, when trouble results in the parts that require lubrication, it is generally owing to the owner's failure to supply lubricants, or to the use of the wrong lubricant, or to some other factor, such as that of crank-case dilution which damages the correct lubricant which may have been supplied actually rendering it a non-lubricant.

Inventive genius keeps working out new and better ways to preclude damage from incorrect or omitted lubrication, but the human equation still remains; and in dealing with the latter the inventor is truly up against it. You cannot make people do their part always right. The only way is to keep talking about it in their hearing or vision, and hope for an approximation to perfection. It is by no means the novice who over-lubricates the most obvious part of the car, the motor, and neglects the dozens of little, hard-to-get-at places on the chassis. The novice is generally conscientious about these, following out the advice of the manufacturers—until he discovers that some older hand makes an apparently good go of it without all this bother. Then he gets careless. Unfortunately, the troubles that result are apt to be delayed for quite a long time. But when they come, there is usually a whole crop of them at about the same time. The buyer of a second-hand car often best realizes this. Everything seems to disintegrate all at once, the result of the previous owner's omissions much earlier in the game.

In the case of a second-hand purchaser who has his eyes open, the resale value of a car which has had its minor lubrication neglected will be very greatly reduced, for he appreciates the general overhauling it will soon require. Such a car squeaks. Squeaking is a cry for lubrication—parts are wearing out fast. Go into the junk-box of any repair garage and paw over the discarded parts you will find there, and you will discover a sermon whose text is "lubrication." Here is a spring shackle bushing that is nearly worn through. Oil or grease would have saved it and the cost of a premature replacement, not to speak of the thousands of squeaks that accompanied the wearing out. Here is a shackle bolt with empty grease cups turned down tight. The driver of that car took pains as long as it was dead easy—then let it go. The shackle bolts are worn one-third through. Next comes a universal joint. There is not much movement in universal joints but there are millions of these small motions. Sooner or later the old lubricant is gone and more is needed. In this case someone forgot it and the thing ran on until the metal was all galled up and in some places had seized. It has been calculated that neglected chassis lubrication alone costs the people of the United States about seventy-five millions of dollars in repair bills every year.

In any discussion of lubrication of the automobile, that of the motor itself naturally occupies the greatest attention. At no other point is there so much relative motion of sliding parts, and this is complicated by the two facts that first, the motor develops a high degree of heat, and, second, that the fuel used in the motor is, before it is burned, introduced directly against the cylinder walls, and here there is more linear motion than at any other point on the car. The first problem, that of the high degree of heat, is being, in fact has been, improved away. Oils having high flash points are no longer difficult to get. But the second problem, that of the fuel, is growing worse. Gasoline is growing less and less volatile. Less and less is it successfully vaporized by the carburetor, and more and more, especially as engine speeds tend to increase, does it reach the firing chamber merely in atomized form. Since about 1910 the consumption of gasoline has increased many fold, and while the production of crude oil, from which it is derived, has increased greatly, it has not increased enough to make it possible to derive, even with the improved "cracking" methods now used, enough gasoline of the old standard to go around. The result is a grade of gasoline which "overlaps" the early kerosene in the sense that part of the constituent of the crude oil that would then have gone into the kerosene now has to go into the gasoline. In this connection it should be stated that this does not mean, as one often hears, that "they are putting kerosene into the 'gas' these days." A direct mixture of kerosene and gasoline would not be a return to the same crude from which these two were obtained. Humpty-dumpty cannot be put back again that simply.

When the lubricating oil became diluted with gasoline this piston seized at high speed. The lower or crank-shaft bearing was not injured

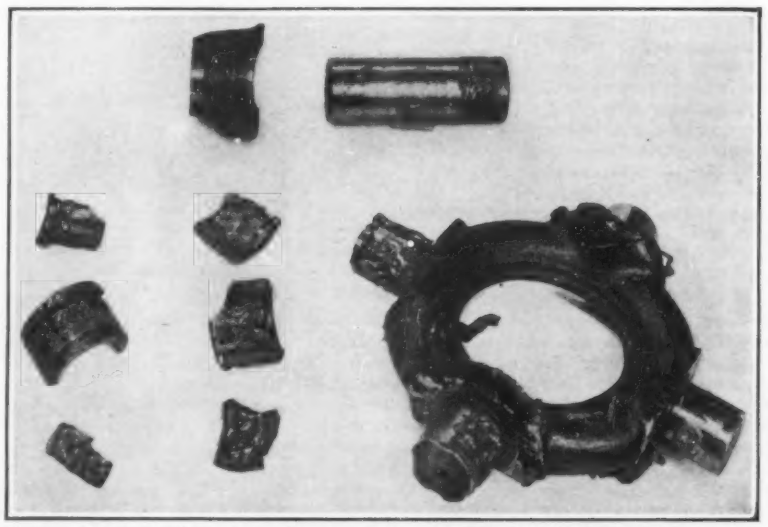
This matter of the lower volatility of present-day gasoline has a very direct bearing on motor lubrication. It gets into the cylinder oil in the crankcase and dilutes it. Engine troubles follow. Once in a while one hears the owner of a car state that his motor consumes almost no oil—in fact, it seems to make its own oil. The truth is that it accumulates more liquid in the crankcase, but that liquid may run even up to a 90 per cent content of gasoline. But gasoline is not a lubricant, even if such a mixture, owing to the carbon and metal particles it contains, has the appearance of partly used oil.

It is because the gasoline is growing less and less volatile from year to year that manufacturers who formerly advised draining the crankcase every thousand miles, are now crowding this maximum down to 500 miles, and in some cases to 300. The low volatilizing quality of the newer fuel means that it reaches the cylinder more and more in the form of spray instead of vapor, and since gases moving through tubes at velocities of over a hundred feet per second take on a whirling motion they are delivered to the combustion chamber with the "atoms" of atomized fuel whirled centrifugally towards the outside of the cylinder walls.

Reaching this point they do just the very worst thing they could do, that is, they wash off the fine film of lubricant that has been left on the walls by the down or suction stroke of the piston. The next up stroke, the compression stroke, greatly helps to move them downward into the crankcase, and more aid is given by the ensuing explosion. The only "cures" at present known for this condition are only partial cures. One is to use very tight rings, a thing that may help considerably. The other is to keep throwing away oil and putting in new. This costs money; but so does poor lubrication. Just now there is a movement towards methods of reclaiming used oil, and if it proves successful we may find it possible to get a rebate on our used crankcase oil, turning it in in small amounts to be reclaimed. We shall then be less unwilling to renew the oil in the crankcase. The new process, it is claimed, returns the old oil at least to the standard of quality of new oil. In fact, the proponents of one process which is soon to be commercialized state that oil reclaimed by this process is a trifle superior to brand new oil. Like a new motor, oil must be "broken in."

In winter, lubrication problems become worse. The car needs more careful watching, for troubles due to faulty lubrication can arise more quickly in cold weather. Probably the chief of these trouble sources comes from using a choked or rich mixture. Since the choke is often used until the motor, as well as the water in the circulation system has reached a temperature that will permit vaporization of all of the fuel, in winter weather this means that a steady trickle of gasoline is finding its way down into the crankcase. This will result in overheating and excessive carbonization. As soon as possible, therefore, the choke should be pushed in and the engine otherwise be kept spinning by traversing the throttle until it has warmed itself up, not forgetting that "roaring" the engine at this time is about the worst thing that could be done to it, since the lubricating oil is not yet warm enough to flow freely just when

(Continued on page 71)



Universal joint failure brought about through lack of lubrication, despite the fact that pins and bearings are case-hardened steel

Balloon Tires and What They Mean

Remarkable Results Obtained by Increasing the Size of Tires and Reducing the Air Pressure

WERE it not for his knowledge of what it would do to them, every motorist would probably prefer to run with poorly inflated tires. Many of them do. It is comfortable; and it lets up on the car as well, for there is much less vibration. Unfortunately, running on pressures in any measure below those for which the tire is designed, injures the tire walls. Not inflating the tire fully, under the belief that it favors the tire by putting it under less stress, is about the worst thing one can do to it. Under these circumstances it gets a sharp flexion at its walls twice with every revolution, and since its thick walls are not designed for this sort of motion, ply separation becomes serious and there is fabric failure on the inside plies. Regular tires cannot withstand much of this sort of punishment.

The new "balloon" tire which has just appeared on the market gets around this difficulty and permits the use of pressures something less than half of those in common use today, because it is made up specially with thin side walls which are not injured by the one thousand flexions per mile of travel, which the side walls receive.

Now if you are going to halve the pressure of the air, then your car, whose weight remains the same, will settle down until the area of contact between the tire and the road is automatically about doubled. On a tire of the sizes now commonly in use, this would cause so much distortion of the shape of the wheel, (regarding the wheel as the wheel plus the tire) that even if you were to give the tire thin walls you would get a condition of extreme distortion which would be highly inefficient from every point of view. The obvious remedy for this would be to do just what the designers of the new tire have done. They have greatly enlarged it. The balloon tires look like great doughnuts, and it has been facetiously suggested that Rube Goldberg, the famous cartoonist, was the inventor of this style of tire because he always portrays an automobile with grossly exaggerated tires!

The work of perfecting the balloon tire was started in 1916, but the World War prevented much being done with the idea until 1920. Then the problem was tackled in earnest. Success came in 1922, and the new tires are now on the market.

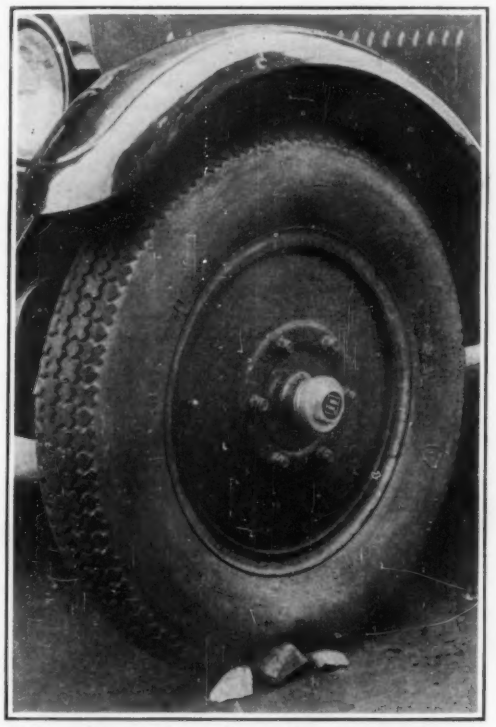
The balloon tire tones down road irregularities simply by enveloping them and going on as if they were not there. This statement must, of course, be limited; but such road obstructions as stones, stray bricks, the low sharp-edged planks at railroad crossings and even broken bottles simply disappear into the tire while it is passing over them. By far the largest proportion of the surface of the tire in contact with the road goes on carrying the car without giving it the usual sharp upward throw. The balloon tire carries only about 35 pounds of pressure, and in some types being developed it carries still less, varying with weight of car, etc.

The sensation produced by riding on a car equipped with the new comfort tires is that of floating along almost wholly in a horizontal plane. It is "riding on mush." There is no comparison in the relative comfort; in fact, it is more a matter of contrast. Long drives will cease to be dreaded, both by the passenger and the driver, for again, the latter finds his work greatly simplified. He no longer finds it necessary to hunt out the most favorable parts of the road, to dodge rough spots, and to slow down when passing another car forces him off the pavement. He does not feel the need of stiffening up as he approaches a bad part of the road. In short, the driver can be careless without being made uncomfortable.

The new tire has a whole list of good qualities; and a few bad ones. Of the latter, two are quite bad, and two are relatively unimportant. The worst feature is made most evident to the passenger in dry weather on dirt roads. The big tires kick up an amount of dust that is described as "terrible." In muddy weather they can easily outdo the common high-pressure tire in splashing mud and water. On the other hand, both of these nuisances are rapidly disappearing as our mileage of paved highways increases.

A lesser drawback is the necessity of equipping the tire with some form of snubbers. Unless this is done it will be liable to develop a sort of galloping action, like some of the almost-extinct "Toonerville Trolleys" of yesteryear which were balanced at their middle on a single truck. Again, the new tire appears to be far more sensitive than the old to improper alinement of the front wheels. The proper amount of toe-in or gather must be arrived at with some care.

Will fuel consumption be increased? Evidently it will, but the increase is very slight, compared to what



Close-up view of a balloon tire, showing how it wraps itself around stones and other road irregularities instead of riding over them.

one would expect with a 7½-inch tire apparently clinging to the road as it runs. Observations made on six taxicabs running a total of 20,000 miles on 7½-inch balloon tires showed an average of 13½ miles per gallon. This compares quite favorably with a larger number of similar cabs using 33 x 4½-inch tires with 70 pounds pressure.

Steering under certain circumstances may be slightly harder with the large tire. Naturally it is much more difficult to turn the front wheels when the car is standing, and somewhat harder to maneuver at low speeds. The tires have a larger contact with the road and therefore cling harder. However, in crossing trolley tracks at an angle so sharp that it is nearly parallel the front wheels are not deflected by the rails in any measure.

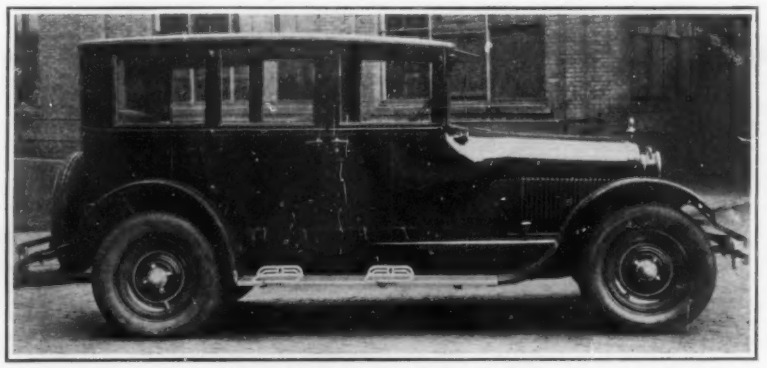
Not only is the low-pressure tire comfortable for the passenger, but it is equally "comfortable" for the car. A million little jolts are swallowed up by the tires every mile, and get no closer to the car body than these large rubber shoes. Car life is extended. It is a safe venture to say that in a few years, when the low-pressure tire is very generally in use, crystallized axles will be rare. The shocks due to road unevenness, that are carried forward from high-pressure tires to the transmission are absorbed by the new tire. This saves the transmission and contributes toward making the car ride more easily. The effect of riding over balloon tires, it is stated, is something like that obtained by jumping from a small inexpensive car to a large heavy car of long wheel-base.

Skidding is practically done away with in the case of the car equipped with balloon tires, according to the manufacturers. In another way danger is greatly lessened. Tests have proved that even at a rapid rate of speed a puncture or blowout with "balloons" is safe, where with ordinary pneumatics the car would swerve and in all probability strike some object.

Touching upon general durability, the performance of balloon tires under average road conditions has, according to the claims of the manufacturers, proved that they possess a surprisingly great degree of ruggedness. For instance, a four-ply, 7½-inch test tire gave out only after first having worn through the breaker and three of the plies. Furthermore, it continued to run on the single remaining ply for a long distance before finally blowing out. Many of these tires have run their entire life with no tread cuts whatever. There have been cases where balloon tires, after 7500 miles of service could when washed up be taken for brand new tires. It is even stated that these tires have been run miles when flat, without damage to either the case or tube.

The explanation of the excessively low rate of wear shown by the low-pressure tire is found in the fact that it is not held so taut as the other. A little thought will make evident the reason for this fact. If one wishes to sandpaper a piece of rubber he will naturally prefer to have it held in a taut, flat position. If one wishes to cut a tough string he will get someone to hold it and pull it out taut. It is the same with the tire. The higher the pressure of inflation the more easily the sharp stones of the road cut and abrade it. Furthermore, the decreased abrasive tendency is not in proportion to the decrease of pressure.

Anyone who has slept on an air-inflated mattress can easily appreciate why a large tire having air at a low pressure is more comfortable. The first time he uses the mattress he will be quite likely to inflate it fully. In this condition the various bumps of his body, corresponding in the analogy to the bumps in the road, will carry more than their share of his weight. Later he will learn that the mattress should be only about two-thirds inflated. When he lies down on it, every bump—his hips, shoulders, etc.—will sink into it, permitting the hollow parts of the body to take up their own fair share of the load. If he turns over, the mattress changes shape, and follows him. The same is true of the balloon tire. This is why it "envelops" little bumps in the road that actually throw the wheel shod with a high-pressure tire off the ground and deliver a shock to the springs and car.



Heavy, closed car provided with balloon tires, indicating to what extent these abnormally large tires alter the usual appearance of a car

There are problems of car design that will have to be worked out before the new tires can be used to best advantage. For one, fenders will have to be made with greater clearance. Axles may have to be lengthened. The new four-wheel brakes may have in the case of some cars to be redesigned. The new tires will in some cases raise the entire car higher from the road. Steering members may have to be altered.

Those who have ridden on cars shod with "comfort" tires find it very hard indeed to find words to describe the sensation produced by them. Floating through space seems to be about the nearest they can approximate the sensation. One experiences a new sense of detachment, as if looking at a motion picture of scenery silently floating past the lens. In fact, according to J. E. Hale, Manager of the Development Department of the Firestone Tire and Rubber Company, it is almost impossible to choose descriptive phraseology to drive home the wonderful effect that these tires have on the riding of the car.

With the Men Who Fly—III

Our Recent Achievements, the Pulitzer Race, Night Mail, the "ZR-1," and Commercial Possibilities

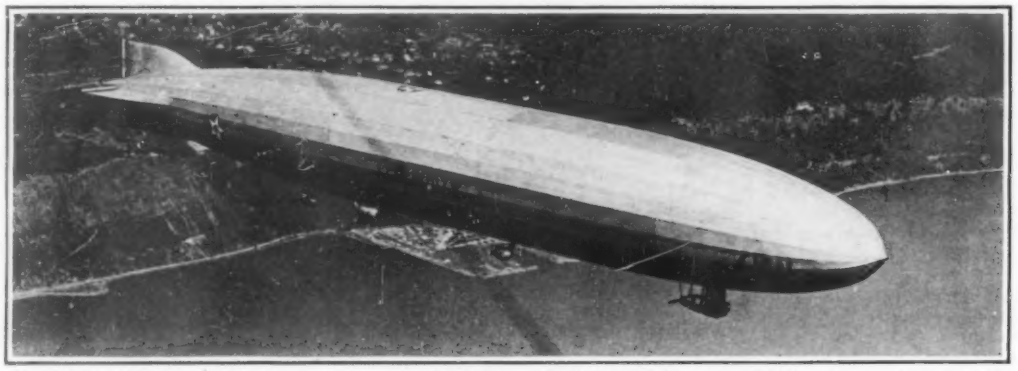
By Alexander Klemin

Associate Professor of Aeronautics, New York University

THE last few months in the history of aviation have brought forth a further series of astounding achievements. And it is a noteworthy fact that they are due to American energy and engineering skill. The one foreign pilot in the Pulitzer race fell far behind Lieutenant "Al" Williams, U. S. N., who won at a speed of more than four miles a minute, and who, but a few weeks back, attained even greater speeds. The Schneider Seaplane Cup is now in the United States, brought home by a Navy team, winning in European waters with another Curtiss ship. It is the United States Postoffice Department which is responsible for a conclusive demonstration of the possibility of night flying on regular schedule. The "ZR-1" is a derivative of German practice, it is true; nevertheless, it is the Navy Bureau of Aeronautics which has had the courage to revive the construction of gigantic dirigibles, in the face of many disastrous experiences and general neglect of this type of aircraft. The Army Air Service may bemoan its lack of equipment and impotence due to small appropriations, but the United States holds most records and leads in technical development. Self-congratulation is certainly permissible, particularly as these events are more than records—they are definite milestones on the road of complete conquest of the air.

The Pulitzer Race

The St. Louis meet is rightly spoken of among airmen as "the greatest in the history of flying." St. Louis business men and bankers had spent over $270,000 in preparing a suitable airdrome and offering prizes to the value of several thousand dollars. They were well rewarded for their efforts. Three hundred airplanes crowded the field, which an average of 50,000 spectators visited each day, including military attaches of foreign governments, army and navy officers, Congressmen, pilots, airplane manufacturers and operators. The "clou" of the meet was the great Pulitzer Cup race, reserved for the last day, which developed new speed records.



Our giant dirigible "ZR-1," now known as the "Shenandoah," in flight, propelled by six engines of 300 horsepower each

Lieutenant A. J. ("Al") Williams, formerly pitcher for the New York Giants, won the race in a Curtiss-Navy racer at an average speed of 243.67 miles per hour over the triangular course of 200 miles. Lieutenant H. J. Brow in a similar machine averaged 241.78, and Lieutenant L. H. Sanderson of the Marine Corps, flying a Navy-Wright plane of 750 horsepower, was third with a speed of 230 miles per hour. Of the seven picked entries, Navy pilots won the first three places. Not a casualty or even a broken wire marked the race itself—a striking tribute to the growing safety of the airplane.

More than 100,000 paid to see this race, and they got their money's worth. When a bomb started the race, the pilots swooped into the air like bullets. The machines seemed to flash across the course. On the last heat, in going round the pylons, pilots banked their machines so sharply that they seemed to rest in the air on their wing tips. When "Al" Williams went round the course he felt sleepy. On turning pylons, his brain refused to function for several seconds. On the last leg he forgot he had finished and went round the course again.

The Winning Ship

There was no betting at the St. Louis meet. There must be superiative skill in piloting, but once the very highest point of piloting skill is reached, there is little scope for the superiority of one man over another. The planes must be in perfect condition. But, granted these two factors, the sporting element is very largely eliminated. Speed in airplane racing is more dependent on basic engineering skill and calculation than even with motor boats or racing cars. The secret of the Curtiss-Navy racer's victory lay in its perfect engineering. In basic principle the airplane has changed very little from the first Wright biplanes. A better wing, but still an inclined plane, provides sustention or lift; the same type of internal combustion motor, acting through the same type of propeller, overcomes the drag or air resistance; the same structural elements are present; practically the same system of air control. But what tremendous difference in the results attained! The secret of the difference lies in the tremendous refinement of each separate element. The Wright brothers were lucky to obtain 40 horsepower from their motor, which weighed nearly 200 pounds. In the race the Curtiss D-12 engine, undoubtedly the most wonderful racing motor in the world, developed fully 500 horsepower, yet it weighed well under 700 pounds, and its area, projected on a plane at right angles to the line of flight, is but a few square feet. In the modern racer or fighting plane there is a tremendous concentration of power. The Curtiss racer weighed only 2097 pounds—not much more than four pounds per horsepower—and with this tremendous power the supporting surface is reduced to the minimum—148 square feet. Less area and but a few hundred pounds more weight than the Wrights flew with, when their motor developed but 40 horsepower and 40 miles an hour was a high speed. The wings of the racer are thin of camber; they provide comparatively little lift at a given speed, but their profile is really beautiful. In addition to the camber on the upper, there is a slight camber on the lower surface, giving the eye a definite impression of "streamline," of offering the very least resistance to motion of any sustaining surface ever designed. And the aerodynamical laboratory shows indeed that their efficiency as measured by the ratio of life to resistance is over 20 to 1. In the early days of aviation 11 to 1 was considered good. Gone is the forest of struts and wires of biplane structures of early days. The wing bracing is now reduced to a minimum—a small I-shaped strut and three streamline wires on either side and direct attachment to the fuselage in the center. The body of the airplane is beautiful in its streamline form, no part of the engine projects—it is all carefully cowled in—even the exhaust stacks are housed in a wing-like covering, and the pilot's cockpit is such that the air flows past it with a minimum disturbance. The chassis must still have rubber cord to absorb the shock of landing, but the entire system of shock absorption is housed within the wheels themselves, removing all harmful air resistance. The propeller is no longer a thick wooden blade, but a thin duralumin forging, thinner and more efficient than is possible with the most carefully designed propeller in oak or mahogany. There is no clumsy automobile type of radiator in evidence. The engine works continuously at full power and must be cooled, but the cooling water circulates through the wings themselves and is therefore freed of its heat without imposing any resistance to motion. By the use of duralumin, strong as mild steel and one-third the weight, the weight of the entire structure is reduced to a minimum, explaining largely the extraordinarily low weight per horsepower it is possible to obtain in the modern racer. It is the refinement of each minute detail, the perfect coordination of aerodynamic efficiency with light structure and light and compact power plant, that won the Pulitzer race rather than any radically new development.

Is There a Limit to Airplane Speed?

The participation of the Army and Navy Air services in the Pulitzer races involves great expenditure. But it is fully justified. The general progress in performance, aerodynamics and construction evolved under the stress of racing conditions is immediately carried over into the construction of practical fighting ships. Ultimately it will be carried over into the field of commercial aviation. If 300 miles an hour were commercially possible, New York to San Francisco would mean less than 10 hours flying, a possibility which would certainly have value. The question arises whether the practical limit of airplane speed has now been reached. From the point of view of the engineer it undoubtedly has not. It is true that the utmost refinement has already been attained in structure, in the use of light materials, in aerodynamic streamlining, in improving wing efficiency and cutting down wing area, and in the power plant. We could fly faster with smaller wings, but then the landing speed would become prohibitively high. But there are still avenues of progress. Suppose a wing could be practically used in which the camber of thickness could be varied at will. Camber is almost synonymous with lifting power. In making a get-away or on landing, the pilot would use a heavy camber to keep the speed down. Once in the air the camber would be reduced to a minimum so as to secure the maximum speed possible. It is difficult enough to build an airplane wing structure which shall be safe and adequately rigid without any moving contrivances, but still there seems no inherent reason why a practical method of camber control should not be developed sooner or later. Variable area has the same basic advantages as variable camber and may be another method of attacking the same problem. Yet a third method of varying at will the lifting capacity of the wing is in the famous Handley-Page slotted wing, whereby the opening of a carefully shaped slot in the leading edge of the wing, in combination with the pulling down of the trailing edge, produces extraordinary results, increasing the lift in some cases by 80 per cent.

It does not seem possible to diminish the resistance of the fuselage very greatly, but it is quite feasible to think of the landing gear being withdrawn in flight into the fuselage, with a corresponding decrease in head resistance and increase in speed, provided always that a simple and entirely dependable mechanical contrivance can be found. In its present form the aviation engine is not susceptible of indefinite improvement in lightness or size for a given power, but experiments are being carried out both in Europe and the United States on what might be called crankless engines, in which the elimination of reciprocating motion has resulted in all the advantages of a gas turbine, namely, extreme compactness and light weight, without its inherent difficulties.

Another line of approach in the securing of tremendously high speeds lies in flying at altitude. The supercharger can be made to maintain the full power of the engine at altitudes of 30,000 feet. Granted this fact, the speed of an airplane can be increased quite appreciably by flight at altitude, where the air offers less sustention but also less resistance. The airplane, to achieve high speeds at ground level, must fly at a small angle where the lift is small, and at this angle the wing is inefficient—its resistance is high in proportion to the lift. At altitude, the low density of the air and the correspondingly smaller lift will permit the machine to be flown at a greater and more efficient angle to the line of flight. The design of an altitude machine involves a thorough understanding of the somewhat intricate aerodynamic principle involved. It also involves the consideration of an adequate supply of air at atmospheric pressure

to pilot and passengers, and electric heating in the great cold of the upper atmosphere. But there are no insuperable problems here.

If these new lines of attack are courageously approached, when the present methods of improvement have been exhausted, speeds of over 300 miles an hour will certainly be within reach.

But perhaps there is a limitation from the human point of view. We have seen that Lieutenant Williams suffered partial loss of consciousness in going round the pylons in the Pulitzer race. When turning the airplane banks, with its lower wing toward the center of the turn, much after the manner of a bicycle going round a corner, centrifugal force tends to throw the plane away from the center of the turn, but the banking or lateral inclination counteracts this so that there is mechanical equilibrium. However, centrifugal force acts not only on the inanimate elements of the airplane, its wood, metal and canvas, it acts also on the body of the pilot, on his frame, which is pressed against the sides of the fuselage, and on the blood which circulates within his body. A simple effort of the imagination will show that the blood will flow away from the brain into the lower parts of the body. In Williams' case this centrifugal force lasted but a moment, and consciousness returned. A more severe effect and consciousness might not return; in other words, death would result. This forms a very weighty argument in favor of the possible limitation of airplane speed, but here again mechanical ingenuity seems likely to overcome all obstacles. Gyroscopic or other controlling devices might be used to obtain flight on an absolutely even keel and in a straight line, the rapidity of turn might be limited, and in commercial flying there is, anyhow, no necessity for anything but the most direct flight between any two points, without violent maneuvers.

Night Mail

Less spectacular than the thrilling St. Louis races, the four-day test runs for night mail between New York and San Francisco have perhaps even a greater importance. The Air Mail Service completed with but little delay the arrangements for illuminating the night leg of the route between Chicago and Cheyenne, Wyo. In a series of eight flights, East to West and West to East, the mail planes maintained an average of 28 hours for the whole run. In spite of bad weather and occasional fog, the test ran with the greatest precision, due to the splendid ground organization, which was on a par with the extremely thorough lighting arrangements, over the 885 miles of the night leg. Regular Air Mail planes were used, namely, old war-time DH ships, rebuilt to suit the needs of the service. Assistant Postmaster General Paul Henderson, in charge of the work, summarizes the results of these tests in words which cannot be improved upon.

"Our tests show that aircraft may be operated at night with certainty, safety and regularity. This opens the door for a new and wide use of aircraft. The dark hours out of the 24 are those most important to the business man from the point of view of the expeditious transportation of his letters, his money, his merchandise. Although airplanes run much faster than trains, except in certain peculiar combinations of distances, part, if not all, of this advantage over trains has heretofore been lost, due to the fact that the train ran 24 hours a day, while the airplane had to stay on the ground at night.

"I really believe that within a relatively short time all important commercial and industrial centers of the United States will be connected up by lighted airways, over which mail, express and other important movements will be made at night, always providing that the distance between such centers exceeds 500 miles, and does not exceed 1200 to 1500 miles.

"There are in the United States scores of potential over-night routes, the outstanding probably being New York and Chicago. Aircraft will fly from New York, leaving after dinner in the evening, arriving in Chicago just before dawn."

Problems Still to be Solved by the Air Mail

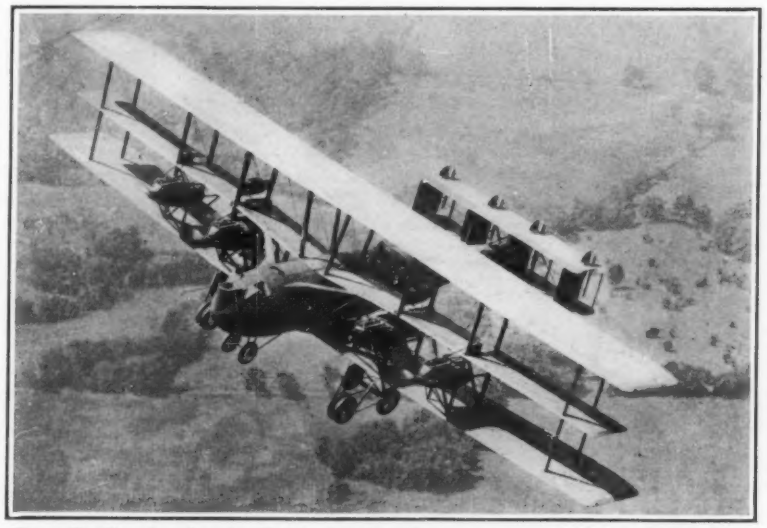
The Air Mail has by no means solved all its problems. Its equipment is to be replaced by more modern ships. Three experimental ships have been built by the Glenn L. Martin Company, the Curtiss Aeroplane & Motor Company and the Aeromarine Company and are being tested out. These ships are based on the experience of the air mail pilots and superintendents and on the records of such flights as Macready and Kelly's, and Maughan's across the continent. Lower landing speeds, more rugged landing gears, greater accessibility to the power plant and a larger useful load or carrying capacity have been sought for and attained. To eliminate gasoline system troubles, in all three ships gasoline is carried in the upper wing, led purely by gravity to the carburetor and thus eliminating gasoline pumps and complicated systems of leads. But in addition to better equipment, the Postoffice has yet to complete its meteorological service arrangements, to install a practical system of wireless communication between the pilot and the airdromes at all fields, to build ships which will land slowly and not spin, and yet fly fast. And if the service is to be entirely independent of weather, some sort of stabilizing device which will enable the pilot to fly in fogs without losing an even keel or circling round and round, is still to be produced that will be simple enough and cheap enough to merit extensive use.

Curtiss-Navy racer which has recently developed speeds close on to 270 miles per hour

But whatever detail improvements are yet to come, there is no doubt now that the Air Mail has definitely established itself as a permanent factor, and that its extension throughout the United States is only a matter of time.

The Giant Dirigible "ZR-1"

The supremacy of the airplane is not left unchallenged, however. After the war the disastrous fate of many of the German Zeppelins, their inability to resist attack from airplanes owing to the inflammable hydrogen with which they were filled, and the ease with which they perished in stormy weather, particularly when going in or out of hangars, led to their general abandonment by European governments. It required great courage on the part of the United States Navy to resume their development and to invest a sum estimated variously as between $1,500,000 and $3,000,000 in the construction of the "ZR-1," now termed the "Shenandoah," at the Naval Air Station in Lakehurst, N. J. The enormous ship is one of the largest dirigibles ever built. Its length is 680 feet, diameter 78 feet, and its gas capacity is 2,150,000 cubic feet of the non-inflammable gas helium. The huge girder structure of the ship contains twenty cells of cotton fabric lined with goldbeaters' skin, a bovine intestinal product unsurpassed for its imperviousness to gas leakage combined with extremely light weight. The structure is made of duralumin, and alloy of aluminum, copper and manganese, which seems to threaten the supremacy of steel in many fields of engineering. The power plant consists of six Packard engines developing 300 horsepower each. A cruising radius of 4500 miles is possible with a full crew of 31 men and equipment, and the total lift of the helium is 103,000 pounds, while the dead weight of the airship is 74,360 pounds.



Huge Barling bomber in flight, showing the arrangement of its power units, cockpits, wings and tail

The "ZR-1" has so far made every voyage a successful one, and its longest trip, to St. Louis, was a non-stop flight of 2200 miles, during which an average speed of 60 miles an hour was maintained. On the return leg of the journey from St. Louis races to its home at Lakehurst, New Jersey, the "ZR-1" covered the 725 miles between Chicago and Lakehurst in twelve hours flat and at a fuel consumption of about five-sixths of a gallon of gasoline per mile. In fact, $150 was the entire fuel bill —but a fraction of the cost of the coal for a limited train running the same distance.

Commercial Possibilities of Dirigibles

The extremely cheap cost of fuel, the apparently uniform success of the trial flights of the "ZR-1," the proposed transatlantic voyage of the "ZR-3," now being built at Friedrichshafen, Germany, for the United States Navy, the decision of the British Government to help finance the so-called "Burney" plan whereby an airship service is to connect Great Britain with Egypt and India and then with New Zealand and Australia—all these factors have strongly revived the interest in the commercial uses of dirigibles. Many large interests are studying the problem closely, and it is forming the subject of much discussion at air conferences and in the technical press. The question is one of tremendous complexity. The safety and possible regularity of service under all weather conditions, the economy of operation, the possible speeds and range, the enormous size and cost of the units which have to be employed, the traffic which may be reasonably expected over a given route, the tremendous capital investment required, the insufficient data on operating costs, the rapid depreciation and other financial factors, are inextricably woven together. Careful analyses have been made both by European and American experts and have shown the most favorable forecasts, with the possibility of enormous profits based on apparently reliable and conscientiously made estimates. But there is nothing conclusive so far, and any dirigible undertaking must of necessity be a gamble on a huge scale. It is not possible within the scope of one short article to study the problem with any degree of completeness. We can but set down a few of the complex factors which enter into the proposition.

Safety and regularity of service are perhaps the most important. Here the outstanding problems are the prevention of fire, adequate structural strength and the handling of the airship in starting on a trip and on landing. The first problem is largely solved by the use of helium, provided helium, now costing some $100 per 1000 cubic feet, can be produced at a cheaper rate. Another plan is to use a cheaper hydrogen inflated airship with a small outer space filled with nitrogen or helium. The substitution of heavy oils for gasoline is another step in the direction of fire prevention. In spite of disasters in the failure of dirigible structures, such as in the case of the ill-fated "R-38," there is no doubt that an airship can now be made structurally strong enough to withstand all the effects of gusts when once in the air, although a dirigible may sway uncomfortably in heavy wind and be considerably harder to keep on its course than a speedy airplane. But the effect of wind becomes extremely difficult when it is sought to bring the airship in or out of a hangar. A small army of men is used to bring the "ZR-1" out of its shed, and even then there is no guarantee against a bad smash against the sides of the hangar. The mooring mast is perhaps the solution here. Mooring masts of gigantic proportions have been designed and built, to which airships can be attached in any weather, and, pivoting round like a weathercock, will always place themselves

(*Continued on page 72*)

The Story of Steel—I

Amazing Growth of the United States Steel Industry in the Past Two Decades

THE story of steel is the story of the astonishing industrial development of the United States during the past quarter of a century. The secret of that development is to be found in the opening up of the enormous deposits of ore in the Missabe range to the north of Lake Superior, and the characteristic American operations on the grand scale in mining, transportation, smelting, and fabricating into steel, by which the contents of that treasure house of Nature's providing have been transformed into ten thousand commodities to meet a world-wide demand.

The magnitude of the steel industry expressed in numerical statistics makes only a shadowy impression to the mind; these figures have to be reduced to some concrete form if any adequate impression is to be conveyed. Thus, the statement that the United States, in the year 1918, mined over sixty-nine million long tons of ore fails to convey an adequate impression of the vastness of this total; but if we should see the entire ore production for that year piled up in a single heap, we would get an instant comprehension of its meaning by comparing it with familiar objects in the landscape. The mind is confused by large numbers, but it grasps quickly the sight of large concrete quantities. The statement that a wagon holds 30,000,000 grains of coal would give a person a very hazy idea of the actual quantity specified; but he would comprehend the quantity at once if he were told that it represented two tons. The larger unit of weight would reduce the count to a figure readily within his mental grasp.

It is because of the above conditions, that the SCIENTIFIC AMERICAN makes such frequent use of the comparative diagrams which have so long maintained their popularity with our readers.

On the front page of this issue we give a graphic comparison of the statistics of the steel industry in the past twenty years. We wish to make it clear that we have chosen for comparison that year in which the quantities of ore, coke, pig and steel, etc., reached their highest figure. This occurred in 1918, that year of feverish industrial activity. As we go to press, the statistics for 1923, are not yet fully available; but there is every indication that they will be fairly close to those of the earlier year. The working forces and general equipment which handled and produced the enormous quantities of 1918 are available, probably in even greater measure, today. Hence, the output of 1918 may be very fairly taken as the measure of our maximum capacity in 1922.

Referring to the diagram, it should be explained that the quantities for 1902 are shown in solid black and those of 1918 in a lighter shade; but it should be remembered that while the vertical columns, etc., of 1902 represent cubical contents, the outlines for 1918 represent the increase, in each case, by superficial area only. Thus in the case of the column showing the quantities of coke, if we take the superficial area of one side of the 1902 output as the basis of comparison, the superficial area of the larger surface shown behind it will represent to scale the increase in the total quantity of coke used in 1918, a year of unusual activity.

Coke

Now we find that in 1902, the amount of coke used in the furnaces of the United States was 16,000,000 tons. Coke is so light in weight that, if the 16,000,000 tons were built up in a column 400 feet square on the base, it would reach an altitude of 6,500 feet. No work built by human hand has ever been erected that would give us, by comparison with this column, any idea of its magnitude; for if the base of the column were situated at sea level, a person at the top would look down on the summit of Mt. Washington, New Hampshire, and he would find that it over-topped every mountain in this country east of the lofty range of the Rocky mountains.

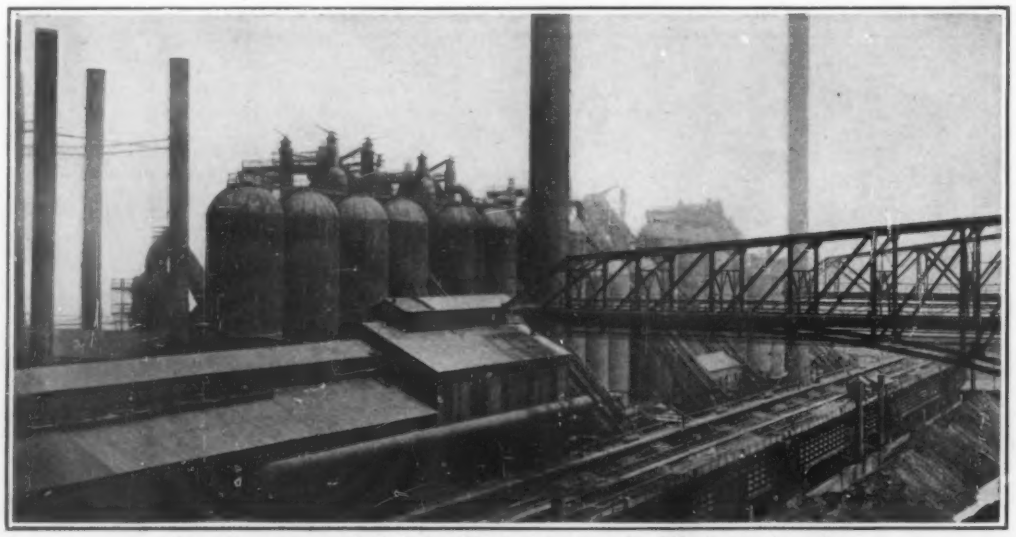
Sixteen years later, the coke used in our furnaces had reached 45,703,594 tons; which would represent also the consumption in 1922, if our furnaces had been worked to maximum capacity. But in 1922 the steel industry had not yet recovered from the depression which began with the great industrial slump of 1919.

Limestone

The limestone used for fluxing purposes in the blast furnaces amounted in 1902 to 9,490,090 tons, which would be represented by a column 5500 feet high on a base 200 feet square. In the year of maximum production, there was consumed a total of 19,208,403 tons of limestone. The purpose of the limestone is to form a flux with the impurities in the blast furnace charge, which, being lighter than the molten pig iron floats on the surface of the iron and may be tapped off separately. Twenty years ago slag thus formed was more or less of a nuisance, and was hauled away to be dumped as one of the wastes of steel making. Increasingly during the past two decades, slag has come to be recognized as useful material for the ballasting of railroad tracks, the building of roads and more lately and above all as a valuable constituent in the manufacturing of cement—an industry which has grown to vast proportion in this country, and is rapidly supplementing, if not supplanting, steel in buildings and bridges.

GROWTH OF STEEL INDUSTRY IN PAST TWO DECADES

	1902.	*1922.*	*1918.*
Ore mined in United States	34,636,121	47,128,572	69,658,278
Coke used in furnaces	16,000,000	29,213,893	45,703,594
Limestone	9,490,090	11,719,638	19,208,403
Pig iron	17,821,307	27,219,904	39,054,644
Rails	2,947,933	2,171,776	2,540,892
Plates and sheets	2,655,409	7,968,397	8,799,135
Wire nails, 100-lb kegs	10,982,246	15,053,330	12,279,800
Cut nails, 100-lb kegs	1,633,762	810,206	418,811
Structural shapes	1,300,326	2,718,768	2,849,969
Steel ingots and castings	14,947,250	35,602,926	44,462,432



Four furnaces, with their hot-blast stoves, at the Illinois steel works

Iron Ore

The iron ore mined in 1902, amounted to 34,636,121 tons. This amount if it could be piled up into a square column, because of the greater weight of the material would represent a much smaller mass than the 16,000,000 tons of coke. If it were built up on a base measuring 200 feet square, it would reach to a height of 6500 feet. The larger output of iron ore shown in our drawing occurred in 1918, when there was mined 69,658,278 tons, of which, by the way, 40,396,711 tons came from the great Missabe range.

Pig Iron

All the great mass of materials above referred to and shown in the first three columns of the illustration were consumed in producing respectively 17,821,307 tons of pig iron in 1902, and 39,054,644 tons of pig iron in 1918. Due to the industrial depression, from which there has been a gradual recovery, the total output of pig iron in 1922 was only 27,219,904 tons.

Steel Ingots and Castings

In the earlier years of the industry, the bulk of the molten iron, as it was run from the smelting furnaces, was cast into pig; but with the development of modern methods, the preliminary casting into pig has been practically abandoned in favor of transferring the molten iron directly to the mixing machines and the Bessemer converters and open hearth furnaces for conversion into steel. The total output of steel ingots and castings in 1902 was 14,947,250 tons. Of this total 9,138,363 tons was converted from "pig" into steel by the Bessemer process, and the balance by the open-hearth process. In 1918, the output was 44,462,432 tons. During the past twenty years, the proportion of open-hearth to Bessemer steel has been steadily increasing, so that in 1922 only 9,376,236 tons out of the total output of the blast furnaces was converted by the Bessemer process.

Steel Rails

It is a curious fact that, in spite of the great increase in production of the various finished steel products, the output of steel rails in 1922 was actually less than that of 1902; the respective totals being 2,947,933 tons in 1902 and 2,171,776 tons in 1922. The explanation of this decline is to be found in the fact that, twenty years ago, we were still in the midst of an era of great expansion of our railroad system, the total amount of new lines constructed in 1902 being 5076 miles. Shortly thereafter, as the needs of the country were supplied, there commenced a falling off in new construction; so that today the total of new work is very limited indeed. That the output of rails is as high as it is may be set down to the fact that the rail renewals on our 260,000 miles of track are sufficient to keep our rail mills fairly well occupied. The rail production of 1902, if formed into a single rail of standard proportions, would be 81 feet high with the same width on the base, and the head of the rail would have a width of 43 feet. A rail built on these proportions would extend for one and one-fifth miles before the year's total tonnage of rail had been included.

Plates and Sheets

The finished product in the steel industry which bulks the largest is that of plates and sheets, the ouput of which has grown in the past twenty years from 2,655,409 tons in 1902 to a maximum output of 8,799,135 tons in 1918. Even this last figure was exceeded in 1920 when the output was 9,737,680 tons. The growth in plates and sheets is shown graphically on our front page engraving, where the 1902 tonnage is represented as rolled into a single sheet of No. 30 standard gage, which would cover the territory shown in dark shade. The larger output of 1918 would cover the area of lighter shade.

Furnace Capacity

The two furnaces which we have shown represent the total capacity of all the furnaces in the country, respectively in 1902 and 1918. The furnace shown in black represents the capacity in 1902. The furnace output today is more than double what it was then; and this brings out the interesting fact that the total number of furnaces has shown only a moderate increase of from 406 in 1902 to 459 in 1918, and this in spite of the fact that in the interval the total output of pig had increased over 100 per cent. This is explained by the fact that the average furnace of today is far larger and more efficient than it was twenty years ago.

Solving Rapid Transit Congestion by the Moving Platform

AS OUR readers are aware, in years past we have given much attention in these columns to the Moving Platform method of transportation. We have always believed, and have so stated, that unless some mechanical or operative difficulties should develop, this system, because of its enormous capacity, presents an ideal solution of the problem of congested local rapid transit. On the other hand, we have been alive to the possibility that the passenger might find difficulty in stepping from a stationary to a moving platform, and have realized that this could be determined only by actual test in a full-size installation.

In order to subject the Moving Platform to such a full-size operative test, Mr. H. S. Putnam, the author of the electrically operated platform which we illustrated in our issue of January, 1923, has recently constructed a complete platform in Jersey City, and for several weeks has been carrying out a series of tests to determine the efficiency of the electrical system by which it is run, and secure reliable statistics as to the weight, resistance and horsepower required, for a given length, speed and passenger capacity of Moving Platform built and operated according to his system.

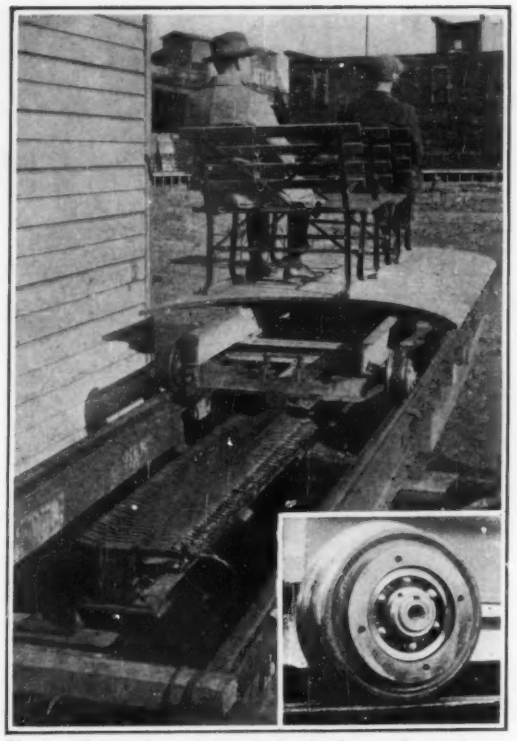
A member of the SCIENTIFIC AMERICAN staff recently visited the Jersey City installation with the thought in mind to satisfy himself on the important question as to whether it was physically possible to walk across the successive platforms to the seats and return from the seats to the stationary platform without any stumbling or confusion. He found that by facing the direction in which the platform was traveling, and leaning slightly forward, it was a simple matter to step successively to the 3-6- and 9-mile per hour platforms and take a seat, and that by leaning slightly backwards and still facing in the direction of travel, it was equally a simple matter to return without stumbling or discomfort to the stationary platform. One handles oneself as one does in stepping on to and off an escalator.

We now give the data, which have been secured as the result of some two thousand tests made on the Jersey City installation, together with the estimates of capacity, horsepower, and cost of operation, as based upon the data so secured.

The capacity of the Moving Platform as compared to present systems of transportation is practically unlimited, as shown by the following figures:

The schedule capacity of the present shuttle service on the 42nd Street subway is 4,400 seats per hour. The proposed Moving Platform on 42nd Street will have a capacity of 35,640 seats per hour. When overload capacity is considered, the present shuttle service has a maximum capacity of 17,600 passengers per hour, as compared with 106,920 overload capacity on the Moving Platform.

The schedule for the operation of the East Side subway at Grand Central Station during the maximum hour calls for the operation of 7,260 seats per hour in the local service, and 13,200 seats per hour in the express service, making a total of 20,460. This, because of delays, is reduced from 10 to 15 per cent during heavy rush hours.



Upper view: A section of the high-speed platform, showing the primary element of the motor straightened out between the rails, and the secondary element mounted along the bottom of the train. Lower view, one of the ball-bearing wheels

The local service on the New York subways is used almost exclusively as a feeder to the express service. If the subways could be relieved of the operation of their trains in local service, these tracks and the equipment could be used for express service, at an actual reduction in the total cost of operation and with an increase of fully 100 per cent in the number of revenue-producing passengers carried. Assuming the strictly local passengers, only, carried on the subway to be 20 per cent, and assuming a 10 per cent reduction in capacity from schedules during rush hours, the maximum capacity of revenue-producing passengers per hour on the subway is now 14,000 seats per hour, and 54,000 including the maximum standing loads. By building parallel subways with a Moving Platform, and with the local train service converted into express service, the maximum seating capacity in express service would be increased to 26,400 per hour and the maximum standing load to 106,000 per hour. The total capacity of the subway with the addition of the Moving Platform would be increased from a total of 20,000 seats per hour to 63,000 seats per hour, and the maximum peak standing load would be increased from 74,500 per hour to 212,500 per hour. These results can be obtained by constructing a Moving Platform paralleling the existing subways, or the new subways when they are built, at a cost of but from 20 to 25 per cent of the cost of a new 4-track subway, and with an increase in operating cost of but from 12 to 15 per cent of the cost of operating a 4-track subway.

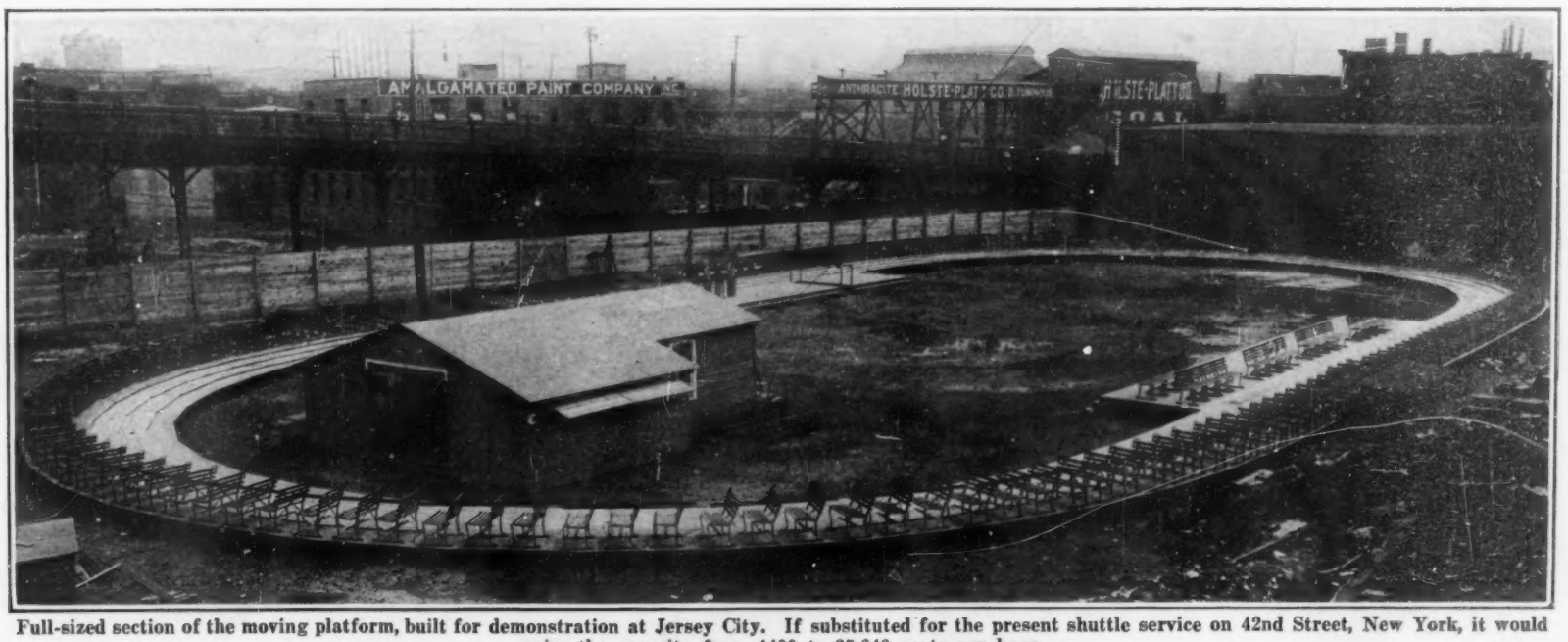
The distinguishing characteristic of the electric system of propulsion as compared to other systems is the method used to propel the car. Instead of mounting a complete motor upon the car and transmitting mechanical power therefrom through gears to the wheels, the elements of a three-phase induction motor of the "squirrel cage" type of winding are separated, the part corresponding to the stationary (primary) element of the motor being straightened out and placed at intervals in the roadbed between the rails, while the part corresponding to the secondary or revolving element is spread out and forms a continuous, short-circuited secondary mounted on the bottom of the car. The primary elements of the motor thus placed between the rails are magnetized by three-phase alternating currents delivered to the windings through cables run in ducts in the roadbed. The primary elements, by induction, magnetize the short-circuited secondary which extends along the bottom of the continuous line of cars above the rails, the result being that the cars are propelled by the magnetic force thus created between the shifting field of the primary and the induced current in the short-circuited secondary on the bottom of the car.

The speed of the Moving Platform approximates three miles per hour for the low-speed platform, six miles per hour for the intermediate platform, and nine miles per hour for the high-speed platform upon which the seats are mounted. The electric system will operate at nearly synchronous speed, and it is proposed to use identical construction for the electrical elements on the three platforms. The different speeds of the platforms are secured by operating the intermediate platform at double the frequency of the low-speed platform, and the high-speed platform at three times the frequency of the low-speed platform. The movement being continuous there is no jolting of the passengers.

Gassing Peach Borers

THE New York Agricultural Experiment Station at Geneva reports that fruit growers have been much interested of late in the use of a chemical compound for peach borers which, under proper conditions, seems to give quite satisfactory control of the pest. This compound goes under the name of paradichlorobenzene and is a common and well-known chemical product which can be secured at a very reasonable price from any reliable dealer in insecticides.

The preparation comes in the form of crystals which are quite volatile and give off a characteristic odor. The usual procedure is to remove any weeds or grass growing around the crown of the peach tree and then place one ounce of the crystals in a ring about the tree. The soil is then drawn over the crystals and banked up slightly about the tree. The gas which is given off from the crystals penetrates the burrows of the peach tree borers and kills the young borers.



Full-sized section of the moving platform, built for demonstration at Jersey City. If substituted for the present shuttle service on 42nd Street, New York, it would raise the capacity from 4400 to 35,640 seats per hour

Life on Board U. S. S. "Colorado"

Changes in Naval Sea Service from 1856 to 1923

By Capt. R. R. Belknap, U. S. N., Battleship Colorado

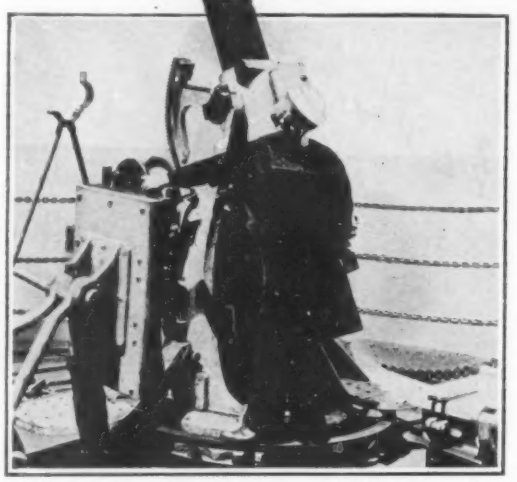
THE "Colorado" is a super-dreadnaught of 32,600 tons trial displacement, 28,000 horsepower, 21 knots speed, and eight 16-inch guns in her main battery. She is 624 feet long, 97¼ feet beam, and about 31 feet in draft of water. Her complement comprises 69 officers, 1266 naval enlisted men and 75 marines. The "Colorado," the "West Virginia," likewise nearing completion, and the "Maryland," commissioned in 1921, three sister ships, are the most powerful and modern battleships in the world.

The new battleship "Colorado" is the third ship in the American Navy to bear that name. The first, named for the Colorado River, was a wooden steam frigate of 3400 tons displacement, mounting 40 guns, launched at the Norfolk Navy Yard on June 19, 1856. She was one of the larger vessels of her time in our Navy, corresponding to the intermediate or 50-gun ship of the days before steam and to the armored or battle cruiser of later periods. Like others of her type, she was a full rigged ship, ordinarily making sea passages under sail alone. As the single screw propeller would then be a drag, it was fitted to uncouple and be lifted clear of the water.

The state of Colorado gave its name to the second man-of-war "Colorado." She was one of six armored cruisers authorized, three at a time, by Congress in 1899 and 1900, of 13,680 tons displacement, carrying four eight-inch guns in two turrets, fourteen six-inch, a score of smaller calibers, and two underwater torpedo tubes. Her Niclausse boilers and four-cylinder, triple expansion engines driving twin screws, developing 27,000 horsepower, attained a maximum speed of over 22 knots. Her ship's company numbered 910. President Roosevelt once witnessed target practice on board and took dinner with the crew in the General Mess, giving his signed photograph as a souvenir. On December 1st, 1916, her name was changed to "Pueblo," after the second city in Colorado, and under this name she served in the Cruiser and Transport Force in the World War under Captain G. W. Williams escorting transports across and after the Armistice bringing 10,136 troops home.

What remarkable changes have taken place between the first "U.S.S. Colorado," built in 1856, and the latest super-dreadnaught of the same name! As a general measure of size, the 3400 tons displacement of the old frigate is grown nearly tenfold; the old seasoned oak hull is now all steel, of thick armored sides and many watertight compartments: full sail power has utterly disappeared and its lofty, wide spreading, slender spars are replaced by tower-like cage masts, topped by large fire control stations; the symmetrical tracery of standing and running rigging is now represented by the bristling, knobby and oddly placed radio antennae.

Down below in the old frigate, rectangular boilers of copper furnished steam at only 25 pounds pressure to a thumping, cumbersome, slow-moving horizontal reciprocating engine, which by means of a single screw drove the ship at ten knots at best, where now oil-burning, tubular steel boilers generate 290 pounds steam pressure for the delicately balanced turbines, adjusted to



High-velocity, anti-air craft gun of which the "Colorado" carries eight on her superstructure

the thousandth of an inch, which, without the least tremor of vibration and with scarce a sigh of sound, spin at about 2100 revolutions a minute, generating alternating, electric current which, by a twelfth reduction, turns four screw propellers 171 revolutions for a shipspeed of 21 knots.

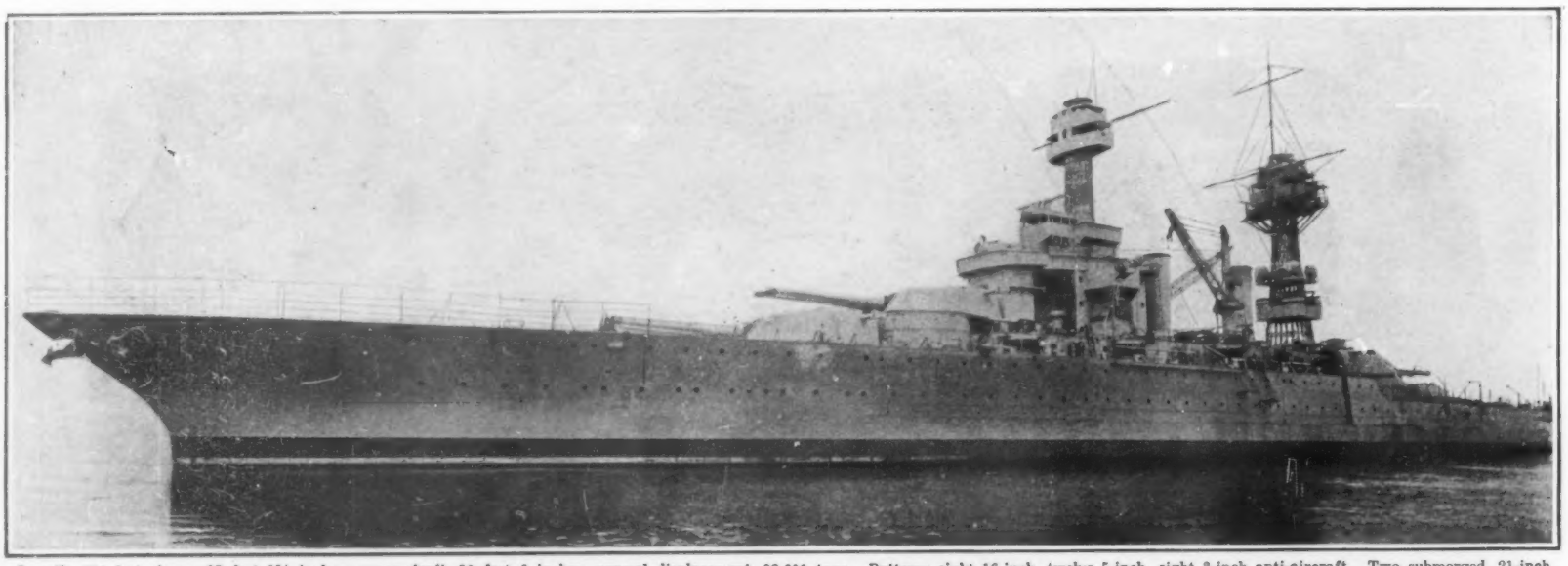
For illumination, oil lamps and candles are retained only for emergency, should electric light fail, and the present brilliant searchlight had no like in the frigate's days. In the day's work, the shrill pipe and hoarse voice of the Bos'n's mates passing the word along the open sweep of decks is all but replaced by speaking tubes, telephone, and other instruments, electric or mechanical, for transmitting communications to scores of separated spaces all through the ship. And at meal times, while Navy beans still hold their own, salt pork, plum duff, and hardtack have given place to refrigerated meat, vegetables, bread, pie, and ice cream.

Of all changes, however, the greatest is in the kind of demands made upon the crew and officers. In the frigate "Colorado," the yards were hoisted and braced about, the sails were reefed and furled, the anchor weighed, the boats rowed and hoisted, the ship steered, and stores whipped on board—all by hand. Handling sail, besides making strong bodies, taught eye, hand, and brain to work nimbly together. In stormy weather a seaman aloft at a dizzy height could work with both hands and exert his full strength, while holding on by his knees or even, in some incredible way, by a grip with his belly. In muscle and wind, in practiced familiarity and dextrous skill, and in observant eye and ready resourcefulness, the square yard sailor was an athlete; but he had a contempt for machinery and of anything savoring of "Science". Seamanship was to him an art, beyond expounding or improving by books.

In contrast, most of the demands for power in the modern battleship "Colorado" are met by machinery. Where formerly two helmsmen, or four in heavy weather, handed a spoked steering wheel, to move the tiller by means of rawhide ropes, there is now no wheel at all, the modern steersman, instead, with one hand pushing an electric control handle right, left, or amidships, with equal ease in any weather, causing electric and oil motors, by means of heavy screw thread transmission, to move the rudder accordingly. An electric windlass below decks inside armor lifts the ten-ton anchors with ease and quickness; two large electric cranes hoist and swing the boats out or in and handle other weights and stores too heavy for the small derricks and winches installed at various points along the ship's sides; while most of the boats themselves, more than twice as large as of old, are gasoline-motor driven.

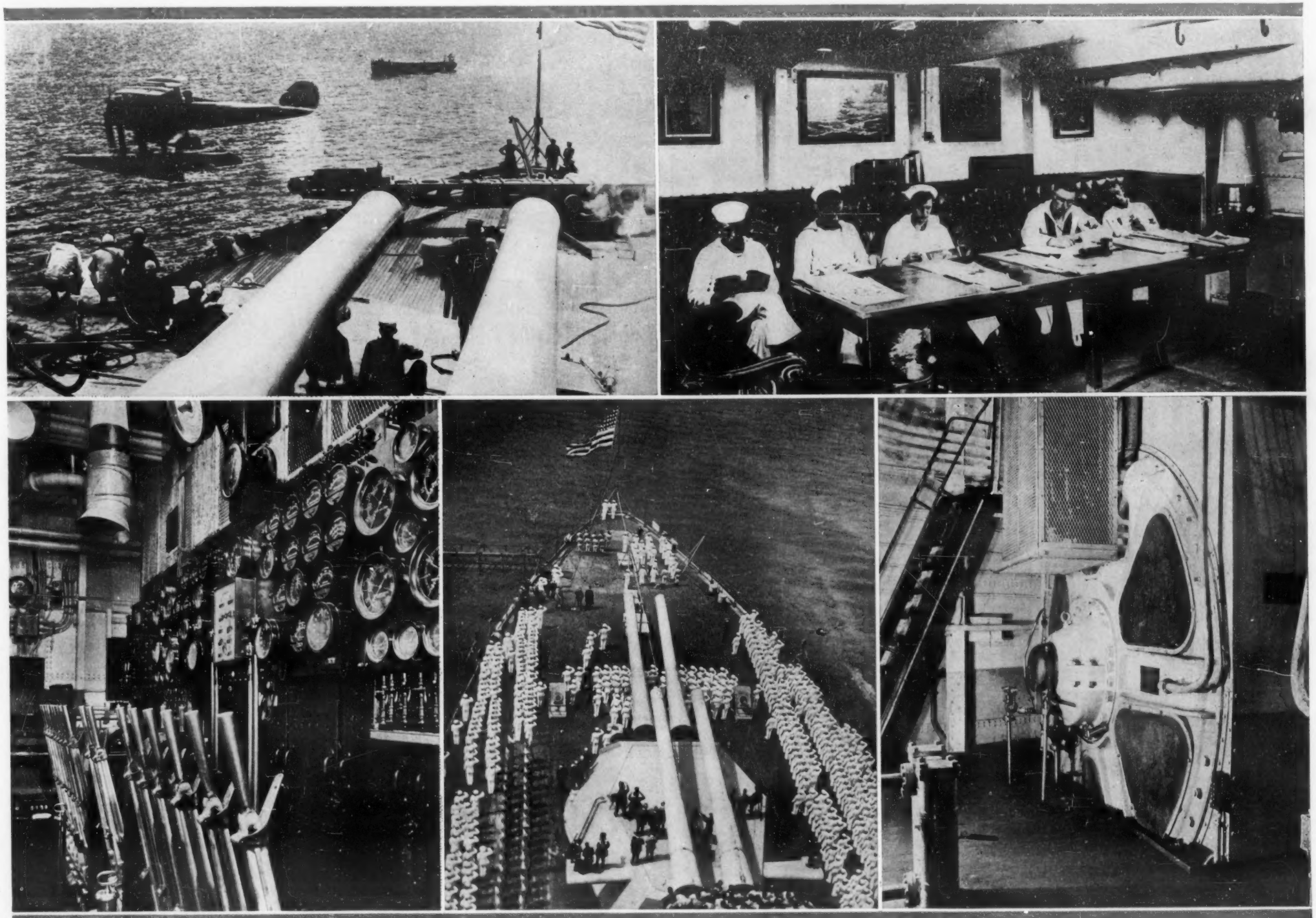
To serve the guns, the old fashioned powder boy, shell whip, hand rammer, and training tackles have been superseded by powerful electric contrivances. Exertion of human strength must, of course, be still required here and there in minor ways, but mostly by individuals, seldom by masses of men, as formerly was common in hoisting topsails, heaving around the capstan to weigh anchor, or otherwise for a "heavy drag." Instead, now a high degree of technical knowledge and skill is needed in many specialties, to control and use the numerous power appliances correctly and keep them in condition reliable for service.

Yet, though athletic qualities are no longer needed for work aloft, a healthy body is essential to the healthy mind, and a cheerful spirit needed for contentment and efficiency. The active, open-air, often strenuous conditions of naval life in all weathers and all climates, both need and tend to make a strong as well as sound body, but as many of the specialties involve long hours below decks, and as ship life is at best confining, the modern naval routine pays considerable attention to physical training, exercise, and recreation, in order to foster and maintain that combination of proficiency, attention, fidelity, responsiveness, initiative, resourcefulness, courage, endurance, and recuperative power, which is summed up in the term morale.



Length, 624 feet; *beam*, 97 feet 3½ inches; *mean draft*, 30 feet 6 inches, *normal displacement*, 32,600 tons. *Battery:* eight 16-inch, twelve 5-inch, eight 3-inch anti-aircraft. Two submerged, 21-inch torpedo tubes. *Protection:* belt, 16-inch to 14-inch; turrets, 18-inch to 9-inch; decks, 3-inch to 1-inch. Underwater, four successive anti-torpedo spaces between outer hull and the vitals.

"Colorado," and her sister ships "West Virginia" and "Maryland" are the most powerful ships afloat



Left upper: Looking aft, showing (foreground) the chase of two sixteen-inch guns, and astern a seaplane leaving the catapult mounted on the quarterdeck. *Right upper:* The comfortable crew's reading room. *Lower left:* Operating platform from which the Westinghouse turbo-electric drive is controlled. *Center:* Looking aft from the maintop, showing the four after sixteen-inch guns and the crew saluting the flag as the "Colorado" (R. R. Belknap, Captain) goes into commission. *Lower right:* Forward end of one of the 8000-horsepower motors

The commissioning of our latest battleship "Colorado"; the mightiest warship afloat

A Five-Hundred-Year-Old Roof

Preserving for Posterity a Noble Specimen of Medieval Carpentry

WESTMINSTER HALL, whose wonderful timber roof forms the subject of this story, is the most ancient of the venerable buildings in Westminster, of which the Abbey is at once the largest and most widely known. The Hall, 69 feet wide by 240 feet in length was built a few years after the Norman conquest, and its present walls are those which the Norman builders erected. The original roof, completed, (so says the Saxon chronicle) in 1099, was supported, it is believed, by the side walls and by two intermediate lines of timber posts. This roof fell into decay, and King Richard II decided upon the erection of a new roof. Presumably, he gave orders that the wide span of 69 feet should be covered without any intermediate supports, such as the posts that helped to carry the former roof.

Westminster Hall, 69 feet wide by 240 feet long; built 1099, was re-roofed in 1397. This magnificent specimen of medieval carpentry stands today, after 525 years of service. It has recently been reinforced by steel framing concealed in the original timber work

Whether it was by the King's order or not, we do know that the Master Carpenter (thought to be Hugh Horland) set about the daring task of roofing this great hall in one clear span from wall to wall, *in timber*—an altogether unprecedented timber structure, both as to its size and the peculiarity of its design. No timber roof of such a span had been attempted before, nor was any such attempted in the centuries of medieval roof construction that followed. Furthermore, because of the enormous size of the original timbers, it is certain that the Westminster Hall roof could not be duplicated *in oak* today; and this for the reason that oak trees of the size necessary to supply such timbers are no longer to be found; they were cut down centuries ago.

Hugh Horland, who must have been of advanced age, for he was in receipt of a pension "for his long and arduous services to the crown," began work upon the roof in 1394. He did his work well; for after enduring the storm and stress of over five centuries, the vast oaken fabric is standing today just as he planned and built it.

But perhaps it would be more correct to say that, so far as the eye can judge, the roof is standing today exactly as he left it; for thanks to the destructive attack of a wood-devouring grub, called Xestobium tesselatum, the interior of these mighty timbers has been eaten away until, in some cases, cavities were left into which a man could creep. A favorite point of attack has been the place of seating of timber upon timber; and the cumulative effect had been that the ridge beam had sagged eighteen inches, and the hammer beams had canted downward at their free ends to the extent of from 10 to 14 inches. The whole roof indeed was in danger of collapse. Repairs were undertaken in May, 1914, continued at a slow rate during the war, and have now been completed.

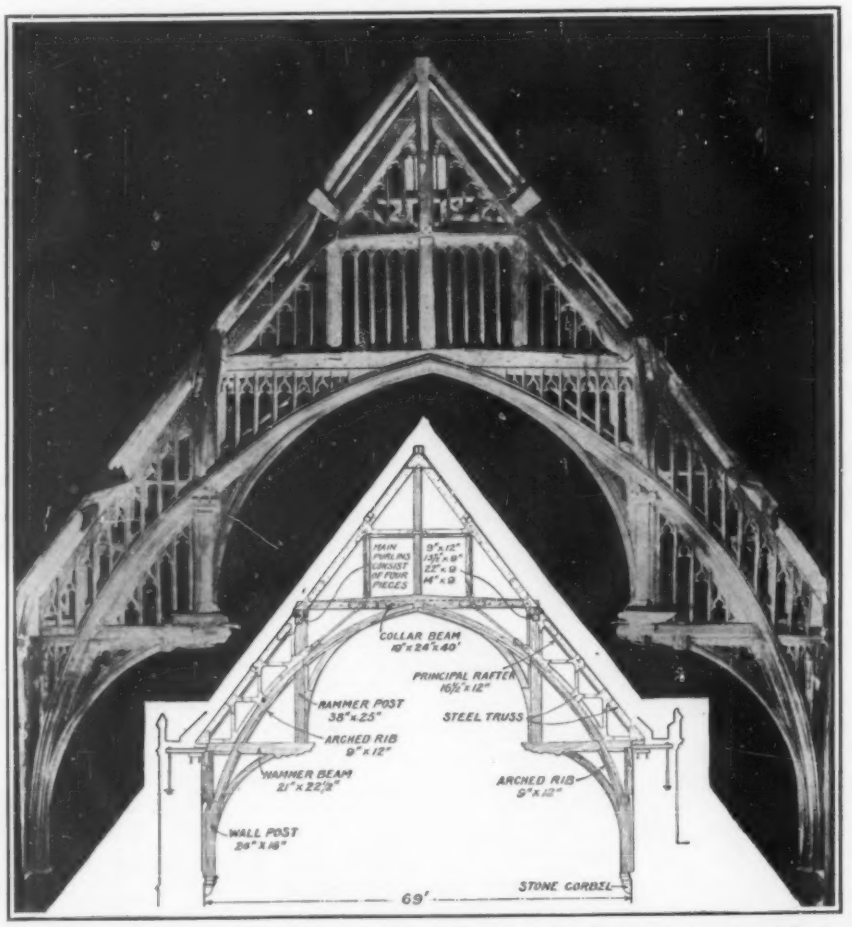
For sentimental reasons it was decided to preserve the original roof intact, and support the great trusses, which are spaced twenty feet apart, by means of a specially designed steel reinforcement, superimposed upon and hidden within the timbers in such a way that it would be practically invisible from the floor of the Hall. The nature of the steel truss and its positioning with regard to the timber truss is shown in the insert line drawing; and its clever concealment is evident from the two photographic views of the roof as repaired.

This most interesting work of salvage was done under Sir Frank Baines, Principal Architect to the Office of Works, to whom we are indebted for our photographs and data. He tells us that Hugh Horland probably found it impossible to obtain oak timbers of sufficient size for the main rafters (about 55 feet long and 16½ by 12 inches in section) or for the main collar beam (two timbers each 40 feet long and 19 by 12 inches in section). The roof was, therefore, designed in two separate parts, namely, an upper, triangulated, framed structure, consisting of the main collar beam, two upper principal rafters and two queen posts, and with a central crown post, resting on the main collar beam and supporting the heavy ridge piece. This upper section was supported on two cantilever structures, one resting on each wall. Each consisted of the lower principal rafter; the horizontal hammer beam, carrying at its outer end the vertical hammer post; the vertical wall post resting on a stone corbel in the wall below; and the curved strut between the center of the wall post and the outer end of the hammer beam.

This wonderful old carpenter finally tied the whole roof together by a great curved brace, or arch spanning the whole width of the Hall from corbel to corbel. It was recessed and pinned into the hammer beam and the hammer post, and at its crown it was mortised snugly into the main collar beam. Sir Frank Baines tells us that this type of roof is known as the "Hammer Beam" because of its construction with horizontal beams projecting from the wall head, which support the vertical hammer posts. These posts with the lower principal rafters provide end supports for the upper triangulated structure, of which the great collar beam forms the base. The downward thrust of the hammer posts on the outer ends of the hammer beams is counteracted by the downward thrust of the principal rafters at their inner ends. They are also maintained in the horizontal position by their attachment to the arched ribs and by the curved braces reaching from their outer ends to the wall post.

Whether Hugh Horland intended the great arched ribs to carry the load (or a part of it) of the collar beam and the structure above or no, we think that it actually must have done so. In fact, when the roof decayed and sagged this arch it was that saved the structure. Proof of this is seen in the fact that so great was the load on its footings, that in one case a massive stone corbel was sheared entirely through.

The timber was cut between 1393 and 1396. The great size of the main members proves that the virgin forests of England must have contained some giant trees. The wood used was peduncular oak from the Sussex Weald, and as there was no time to season it, the timber was used green and, therefore, was extremely heavy. We have estimated the quantities of material in one main truss and its load of one-half of the roofing in each adjoining bay and find that the total combined weight, if we include the lead sheathing of those days is about seventy tons.



The photograph shows one of the twelve great trusses after the repairs. The insert shows the steel reinforcement and the great dimensions of the oak timbers of the original roof. Each truss, with its load of lead-covered roof, as built of heavy, unseasoned oak, weighed seventy tons

The famous Westminster Hall timber roof

As showing the size of the timbers, the hammer beams are 21″ x 22½″ by 17′ 9″ long; the hammer posts, 38″ x 25″ by 20′ 9″ long; the collar beams, two timbers each 19″ x 12″ by 40′ long; the main rafters 17″ x 12″ by 28′ 6″ long; and the main purlins, running from main truss to main truss at the level of the collar beam, were built up of four timbers 9″ x 12″, 13½″ x 9″, 22″ x 9″ and 14″ x 9″—all 18′ 10″ long.

We may ask why Horland did not save weight by giving his roof a lower pitch. The answer is that it would have involved a greater horizontal thrust against the walls, and he had no steel tie rods to take care of this. There is not a bit of metal in the whole structure.

The architectural beauty of this great roof is universally admitted. Of the wonderful strength and endurance of the oak, which (in the testing machine) shows that it has in nowise deteriorated, leads Sir Frank to say "It is difficult to say that steel or masonry would have been so perfect after so long a period"; and speaking of the way in which the work was executed he says "with the present-day knowledge of construction, we must admit, with entire humility, we could find very little fault with the timber construction of this roof and could hardly improve it."

A New Technique of Anesthesia

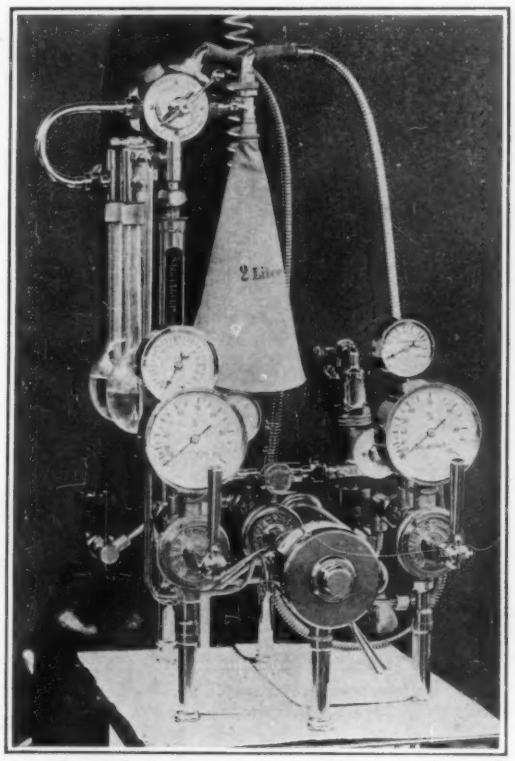
By Dr. Alfred Gradenwitz

BOTH the medical practitioner and the man in the street generally connect with the idea of narcosis that of nausea and vomiting. In fact, common experience shows that the state of patients on the day following a surgical operation is almost invariably influenced by "post-narcotic" nausea, and endeavors so far made to eliminate these disturbing phenomena have only been partly successful.

However, a decidedly new method has just been developed by Drs. C. J. Gauss, of Freiburg, and Hermann Wieland, of Koenigsberg, which not only eliminates these unpleasant consequences of narcosis, but even does away with any harmful effects on respiration and blood circulation.

Experiments on animals had shown nitrous oxide only to act on such manifestations of life as are bound up with the presence of oxygen, while leaving those lower organisms which, like certain worms, are independent of oxygen entirely unaffected. This behavior strikingly differs from that of narcotics proper, such as chloroform and ether, as well as the group of synthetic soporifics, all of which will paralyze the functions of any animal cell—in fact, any kind of living matter. Now, inasmuch as nitrous oxide only acts on phenomena connected with the absorption of oxygen, which action is readily compensated for by some slight admixture of oxygen, the narcotic effect of this gas on the brain seemed to be due to a disturbance in the absorption or utilization of oxygen in the nerve cells. Nor could it be a case of simple asphyxia, as occurring after the inhalation of nitrogen, hydrogen or the like, the symptoms of carbonic acid poisoning (difficulty of breathing and cramps) being practically entirely wanting. Again, the two experimenters, having noted that nitrous oxide possesses an exceptional solubility in water, rapidly resulting in accumulation in the blood and tissues, were led to think that the presence of some other gas might produce paralyzing effects of a similar nature. This was tested by examining the effect of another gas in which water dissolves even more readily than nitrous oxide, viz., acetylene, which was found to be mainly identical with the effect of nitrous oxide, all processes independent of oxygen being left unaffected, while the inhibition induced in higher animals in every detail resembles nitrous oxide narcosis. At the same time there is a remarkable quantitative difference; acetylene, in accordance with its higher solubility, being much more efficient and requiring much lower concentrations than nitrous oxide demands.

The use of nitrous oxide as a narcotic has lately been finding increasing favor in surgery, gynecology, etc., though this gas not only is unsuitable for any more extensive operations, but entails considerable risk of asphyxia, while the admixture of air is bound to counteract its effects. Acetylene on the other hand is free from these drawbacks, the presence of oxygen not interfering with its efficiency, so that unconsciousness can be continued much longer, possibly for many hours, without any necessity of applying excessive pressures. This remarkable behavior is due both to the absence of any harmful circulation trouble and to a considerable reduction of combustion processes in the organism. In fact, the originators of the new method are inclined to describe it as a means of producing unconsciousness rather than narcosis proper.



Acetylene inhaling apparatus used in connection with the new technique of anesthesia

Pure acetylene (or "narcylene" as it is termed in the present case), free from any impurities, primarily from any poisonous hydrogen phosphide and accordingly devoid of the familiar penetrating smell, was used in these experiments, the slightly bitter taste of the gas being hardly felt on breathing with closed mouth. Narcylene is mixed with oxygen derived from the familiar commercial type of steel cylinder. The inhaling apparatus illustrated was constructed by Messrs. Drägerwerk, of Lübeck, and is shortly described in the following:

A platform designed to travel on six idlers comprises two fittings for oxygen cylinders, each of ten liters capacity, and one fitting for an acetylene cylinder of 30-40 liters capacity, flexible high-pressure tubes connecting the cylinder valves with two pressure-reduction valves for oxygen and acetylene respectively, visible to the right and left in the lower part of the figure. Between these valves is seen a circular slide for checking the gas mixture in conjunction with the vertical gage and scale visible in the upper part of the figure. To the left of this are provided an acetylene washing-bottle and a similar bottle for moistening and washing the gas mixture. The bag visible in the middle is inflated more or less by the entering gas mixture, its variable volume enabling the experimenter readily to gage the amount the patient requires for breathing. A reaction valve, readily lifted during inhalation and which during expiration closes of its own accord, prevents the patient's exhaling any used-up air into the conduit, this air escaping through a readily movable valve fitted to the mask. An apparatus for producing oxygen-ether narcosis is also used as a stand-by.

Electric contact apparatus for giving local treatments without risk of deranging the bodily functions by passage of the current through the system as a whole

While the new narcotising process is free from the drawbacks outlined in the beginning, the rapidity with which the patient's unconsciousness and any feeling of pain vanish, and normal conditions return, after the gas supply has been discontinued, are further valuable features both to the practitioner and patient.

Haze and Mist

PERFECTLY pure air is almost completely transparent to visual light waves, and if the air were always pure we should see distant objects through air almost as clearly as through a vacuum. But the air is never pure; there are always more or less particles of foreign matter present. The action of the particles is twofold; first, they reduce the amount of light reaching the eye from distant objects; and, secondly, in the daytime they scatter the general light of the sky and so send to the eye extraneous light which reduces the contrast between distant light and dark objects on which visibility depends. Generally this foreign matter consists of a mixture of solid ponderable particles and hygroscopic molecules. The latter in perfectly dry air would be practically invisible, but when loaded with water in a humid atmosphere they add to the obscurity of the atmosphere.

The amount of obscurity will, therefore, vary with the amount of solid matter and with the humidity of the air. Haze is due to this kind of obscurity, and varies in intensity from the slight obscurity of polar regions, which depends almost entirely on the hygroscopic particles, to the dense obscurity of a dust storm in tropical regions, which is due almost entirely to solid particles.

When the temperature of air falls, the humidity increases until the saturation point is reached. The diameters of the hygroscopic particles grow, but even in saturated air, the amount of water extracted is not great, and if there is little solid matter present the obscurity is not marked. But if the temperature falls below the dew point the hygroscopic particles are sufficiently large to form excellent nuclei for condensation, and relatively large amounts of water are deposited for small falls of temperature. Real condensation has now commenced, and the obscurity changes from that of haze to that of mist. It has been a common practice to record atmospheric obscurity as haze when there is a noticeable difference between the readings of the wet- and dry-bulb thermometers, and as mist when the readings are the same. This, however, is not a true criterion, for the air can be saturated without condensation while mist cannot be formed until water has been condensed on account of a fall of temperature after the dew point has been reached. The whole process of the formation of haze and mist is continuous, and in practice it is practically impossible to say when haze becomes mist, although extreme cases are easily distinguished. Nevertheless, haze and mist are fundamentally different, for haze owes its origin to foreign matter, and the small amount of water associated with hygroscopic nuclei, while mist is due to an actual precipitation of water from vapor to liquid.—*Abstract from article in Nature for April 14, 1923, by G. C. Simpson, F. R. S.*

New Facts About the Curative Powers of Electricity

THE opinion generally held, that the curative powers of electricity were first discovered by Siemens in 1844, is one of the many errors hallowed by tradition. In fact, while the use of electricity for medical purposes had been recommended as far back as about 100 years before Siemens, by the Halle physicist Prof. Klüger, the first undoubted curative success attributable to electricity—viz., the healing of a paralyzed arm—was made public by a Swiss physicist, Prof. Jallabert, of Geneva, only a few years afterward, *i.e.*, in 1747.

This information is derived from a book just published by a contemporary Swiss scientist, Mr. E. K. Mueller, of Zurich, whose investigations have greatly contributed to elucidating the action of electricity on the human body. In this book he also draws attention to the fact that the body is itself traversed by a wonderfully complicated system of electric currents, which, flowing up and down on intricate paths, attend the vital functions of the organism, so that the application of electric currents from outside, if improperly controlled, is apt to interfere with these life-giving currents and thus to counteract the desired curative effect.

This risk is definitely avoided by the new electrotherapeutic method developed by Mr. Muller and which, briefly summarized, could be described as follows: Instead of using electrodes having a considerable contact surface, "edge"-electrodes are employed which come in contact with the skin along what is practically equivalent to a mere contact line, the anode and cathode being separated by a fraction of a millimeter, so that the current, immediately after entering the skin, is caused to leave it, without any risk of straying off towards the interior. By moving this pair of electrodes up and down the skin, any portion desired can be submitted to the treatment, and some sort of electrostatic suction is added to the immediate pricking effect of the current thus applied. Remarkable results are said to have been obtained in soothing the nerves and allaying pain.

Electrifying Chile's Railways

When Abundant Water Power Takes the Place of Expensive Imported Coal

By Lloyd Jacquet

CHILE is a ribbon of a country, a narrow strip stretched between the Pacific and the high mountains of the Andes. Although the country has a coastline of nearly three thousand miles, its average breadth is not more than ninety. It is a land of extreme contrasts, of deserts, of fertile pampas, of snow-crowned mountains and burning plains. It has peculiar problems, because of its climatic conditions, geographical location and economical position, which no other South American republic possesses.

Perhaps the chief trait of the Chilean is his progressiveness. As far back as 1852, the Caplapo line, a small railroad running between that celebrated copper mine and the little port of Caldera, 55 kilometers distant, was opened to traffic. Actually, this may be called the first steam railroad in South America, although some give first place to the Demarara line established in British Guiana.

Chile's transportation problem is a peculiar one. The railroad lines are running through her territorial length north and south. This system is located inland, but a number of transverse lines connect these main lines with the sea. Take, for instance, the central line from Tacna, in the north, running southward to Puerto Montt, at the edge of the Gulf Reloncavi, a distance of 1500 miles. This main line is connected to the Pacific, with branches along the coast at thirty different points.

Type of steam locomotive which will be replaced by electric locomotives on the Chilean State Railway

One of the most important branches, both because the terminal is at Valparaiso, the capital, and, because it is the beginning of the Transandean system, is located in about the middle of the long Chilean strip, and in the most fertile portion of the country, along the Aconcagua River.

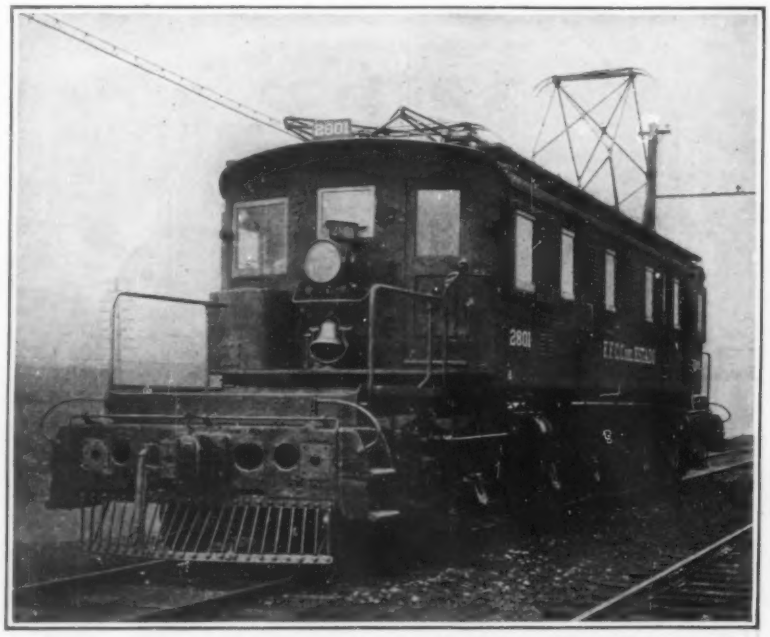
The remarkable part about this branch is that it extends to Santiago, far inland, and it is the only line which is electrified. This is a most important experiment in the history of railroading in South America.

Chile is not so fortunate in her coal supply, when it is considered that almost two-thirds of the coal consumed is imported, and of this amount the railroads use more than one-third. The fuel problem became acute during the war, when operating costs rose to such an extent that the railroads were actually operating at a deficit.

While the country was endeavoring to solve a railroad problem, precious water power was going to waste. The harnessing of this natural resource for power would make the country practically independent, as far as fuel was concerned, and would permit the electrification of railroads as the best solution to the railroad problem.

Accordingly, a commission was appointed and a careful analysis of electrification systems throughout the world was made. As a result of the study made principally concerning the economies in maintenance obtainable with the electric locomotives, the possibility for regeneration on descending grades, the elimination of watering and coaling stations, the increased traffic facilities in general, the electrification of the broad-gage line from Valparaiso to Santiago, including the Los Andes branch, was decided upon. The lines now being electrified comprise a total of 233 track miles, and include the main divisions connecting Valparaiso, the seaport, with Santiago, the Chilean terminus of the Transandean system, and a branch line to Los Andes. The railroad runs along the coast line of Valparaiso harbor, follows the Aconcagua River after going over a low range of hills to Las Vegas, where the Los Andes branch leaves the main line. At Calera, the Longitudinal Railroad starts northward. Llai Llai, almost midway between Valparaiso and Santiago, is the junction point for all passenger trains for the Los Andes branch. It is at this point that the heavy grade section over the Coast Range Mountains begins and continues as far as Batuco, on the eastern side.

Although there are many curves on the line, these may be said to be of medium severity. The most severe curves are located on the section of the line between Llai Llai and Til Til, with the maximum curve of 10 degrees near Los Loros. However, the grade conditions are the greatest problem, and have always been a big obstacle in the rapid moving and expediting of traffic, particularly when steam was used. On some of the grades such as the Tabon grade of 2¼ per cent, which is a little over 12 miles in length, passenger trains require the service of helpers, but, with the electric drive, helpers will be needed only for heavy freight trains. The next heaviest grade is on the eastern slope and is located near San Ramon. It is 1.81 per cent, and it is therefore evident that the heaviest hauling conditions are imposed on south-bound trains—that is, those travelling toward Santiago.



Electric express passenger locomotive for the Chilean State Railway. This locomotive will haul a 300-ton train at over 60 miles per hour

Thirty-nine electric locomotives of the Baldwin-Westinghouse type are being used on the electrified section. These take the place of about 100 steam locomotives. The electric locomotives which have been supplied are divided as follows:

Six express passenger locomotives, each one of the 2250 h.p. type, weighing 259,800 lb., capable of making over 60 m.p.h. with a 300-ton trailing load; length 58 ft. 5 in.

Fifteen road freight locomotives, each of 1680 h.p. and 230,000 lb., capable of making 35 m.p.h. with a 770-ton trailing load; total length 49 ft. 9½ in.

Eleven local passenger locomotives, each 1500 h.p., weight 80 tons, total length 41 feet, maximum 56 miles per hour.

Seven switching locomotives, each 480 h.p., weight 67 tons, and maximum speed 34 miles per hour.

These locomotives make use of a very ingenious device for electric regeneration, which permits a train coming down a grade to generate electric energy, which is sent back to the line, to be used by other trains in service. In this manner, the electric regeneration not only saves electric energy, but also provides further safety for the trains, because it acts as a continuous and adjustable break when the train is on a descending grade.

Of the total number of locomotives, there are already in Chile 14 freight and 6 express passenger locomotives, which as they arrived were assembled by Chilean workmen under the direction of Westinghouse personnel. All of the switcher and local passenger locomotives have also left the Westinghouse plant at East Pittsburgh and are en route to Chile.

The electric power for working the railroad will be derived from hydroelectric plants. The first generating plant, which contains three 8125 Kva. Westinghouse generators, will have an ultimate capacity of approximately 30,000 kw. It is located near Santiago, and is known as the Maitines station, and transmits the power to that city by twin-circuit 110,000-volt transmission lines supported by steel towers. At Santiago the line is connected to the power system of that city, where a combination of steam and hydroelectric plants produce a total of 120,000 kw. of electrical energy.

The object of the substations, of which there are five, is to transform the three-phase high-tension current which comes from the hydroelectric plants into 3000 volt D. C., which is used in the locomotives. The substations are located at Quilicura, Rungue, Llai Llai, San Pedro and Vina del Mar. The first and the last of these receive 12,000-volt current, and the other three, 44,000-volt current. The buildings are entirely of steel and concrete and are especially designed to withstand earthquakes.

They are equipped with overhead cranes, and the basement of each building provides ample space for control equipment. In each substation are placed two Westinghouse 2,000 kw. motor generator units. These units are of unusually rugged construction, and will withstand an overload of 200 per cent for five minutes without injury. The sets are protected by flash suppressors developed by the Westinghouse Company, and which have already proven so efficient on the Chicago, Milwaukee & St. Paul Railway electrification in the United States.

For the overhead construction, the simple catenary type with flexible hangers was adopted. The overhead construction has a span of 60 meters and the trolley wires are suspended at a height of about six meters above the rails, except at the tunnels, where the height is materially less.

A record was established for unusual shipments in connection with this order. The first shipment consisted of 34 cars of apparatus, which made up two complete substation units of the five included in the contract. The second shipment was even larger than the first, and consisted of 33 cars laden with three complete substation units. Later, six complete electric locomotives were crated and packed as a single shipment.

Interest in this event is not confined to Chile, however. The United States is also directly concerned, because this electrification project opens the way for many other large undertakings in South America.

Science and Blankets

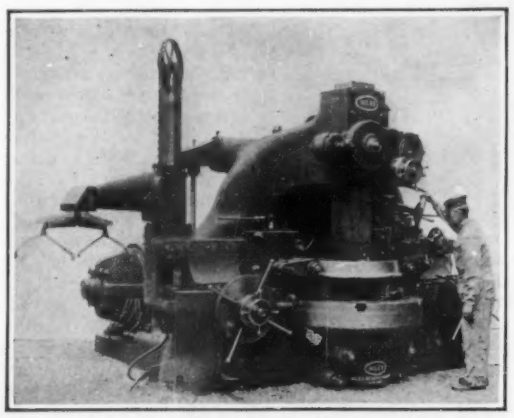
SPEAKING of strange contraptions, one must visit the textile laboratory of the Bureau of Standards to see the latest styles in testing equipment—curious apparatus that takes the blank out of blankets by providing efficient means of solving scientific riddles which heretofore have perplexed textile factories in this and foreign countries. The old drab-colored army blanket has become the object of detailed laboratory tests. The devices installed by the government experts facilitate the minute and accurate try-out of all kinds of blanket materials under laboratory conditions. The old woolen bed cover with its red-fringed border no longer holds any dark secrets which baffle science.

Anyone who, on a camping trip during rainy weather, has had occasion to sleep under a rubber blanket has been annoyed in the morning to discover that his clothes were slightly damp. This was due to the accumulation of moisture given off by the body, which was unable to escape through the impenetrable rubber. This simple little test will convince you that for comfort and satisfaction the average woolen or cotton blanket must be a good conductor of moisture as well as being permeable to air circulation. To find out the moisture-conductive properties of the ordinary blanket rapidly and accurately, Uncle Sam's textile specialists at Washington have perfected a novel testing pan equipped with eleven special glass beakers. Each beaker contains a carefully weighed amount of water. The top of the beaker is covered with a piece of blanket, stretched under constant uniform tension and glued into place.

The metal pan is provided with an unusual propeller operated by a small electric motor. This device keeps the water in the pan in constant circulation. Electrical resistance coils are used to heat the water in the curious container to 98.2 degrees Fahrenheit—normal blood temperature. These coils are wrapped around the pan and one of them extends into its interior. Eleven different kinds of blanket cloth can be tested simultaneously. Each sample is glued in place over the open end of the beaker which contains a known amount of water. Then all the beakers are set in the respective circular holes to accommodate them in the top of the pan. At stated periods they are removed and weighed. The loss of weight in each case is the measure of the moisture that has dissipated through the cloth, and shows the moisture-conductive ability of that particular material.

To test out how well air may circulate through the various blankets, a special metal cylinder eight inches in diameter is used. Over its open end a piece of the blanket cloth is stretched tightly under the same constant tension—between three and four pounds to the square inch—as that applied in the previous test. Then vacuum air under light pressure is fed into the cylinder. An ordinary gas meter is used to record the amount of air that enters the cylinder, while other registering devices keep tab on the proportion of the air that flows through the blanketed end of the container. The temperature of the air is held at about sixty degrees. This test demonstrates the air-permeability properties of the blanket.

Another extraordinary blanket test consists in stretching the cloth under uniform tension over the top of a curious metal table so equipped with electric batteries and resistance coils that the ends and bottom of the blanket are maintained at a constant temperature of the same heat degree as that applied to the blanket. The arrangement is such that the radiant heat can escape only through the top of the covering. A galvanometer is used to record the amount of heat given off at different distances above the surface of the blanket. The heat applied to the blanket is the same as the average heat of the human body, thus duplicating the conditions that would occur where the blanket was in actual use as an article of bedding. The best blankets show the proper balance in the matters of moisture conductivity, air permeability and heat transmission. As the result of the standardization of satisfactory blanket-testing methods, it is certain that the future production of American blankets will be minus many of the faults and defects that now sometimes occur.



One machine that does the work of ten in making rolled-steel car-wheels

Steel Wheels for Twentieth-Century Railroads

THE beginning of the present century saw the start of a race on the part of the big railroad systems of this country for attaining supremacy in covering given distances in the shortest time. The strain of shorter schedules was soon felt. Premature breakdown of equipment resulted. Wear took its toll much sooner. One way only of maintaining such schedules was open. The quality of the equipment and its component parts had to be improved, and improved enough to care not only for the added rack induced by speed, but also the greater stresses imposed by increased weight.

No part of the running gear was more vitally affected than the wheels themselves. The demand was felt for a wheel that would better stand the abuse than steel-tired wheels, which at that time held sway in wheel-making science. Research and experiment established the fact that solid wheels made from hot-worked steel were better from a mechanical standpoint, and it only remained to be ascertained whether their production could be placed on an economical basis. One of the old established steel companies, pioneering along these

Testing the moisture- and air-permeability of blankets

lines, succeeded in accomplishing this result in the late '90s, and wheels made by hot-working the component metal began rapidly to enter railroad practice.

This product came to be known as a "rolled steel wheel," because of the process first followed in producing it—a process that has persevered until today, although several methods of forging wheels mechanically have since been developed. The generic term "rolled wheels" still holds largely in railroad practice when designating any hot-worked steel wheel, regardless of the method of manufacture.

Rolled steel wheels now serve as truck, tender and trailer wheels on over eighty per cent of our locomotives and on nearly the same percentage of passenger cars. Their application to freight cars has been much slower because such equipment is not subjected to speed conditions as severe as in the case of passenger rolling stock.

The makers of rolled wheels are required to deliver their output to their customers, whether railroads, car or locomotive builders, completely machined. The operations called for include rough turning and finishing the tread and flange of the wheel, facing both sides of the hubs and rough-boring and finishing ready for mounting on the axle. Up to the present this machine work has been handled in nearly all cases on tire mills, wheel borers and boring mills, all of heavy, fast operating design. However, the feeling grew that the industry required a special high-production machine designed solely for machining car wheels more expeditiously and by the use of which many machines could be eliminated, floor space saved, labor reduced, less power used, extra

A safe place for the paint pot

rehandling of wheels avoided and the flow of wheels from the rough steel billet to the delivery platform smoothed out and hastened.

The officials of one of the largest steel companies concerned, taking the attitude that they could not possibly be as experienced in developing such a machine as a machine tool builder would be, decided to make known their needs to some leading manufacturer in that field. The nature of the proposed machine, and more particularly what would be expected of it, were outlined. The engineers of the machine-tool concern were asked their opinion on the feasibility of such a machine and questions were put to them as to how much time would be required for the design and construction of an experimental machine to determine whether a satisfactory output could be reached.

The first machine upheld the promises made and the results sought and is now at work in the plant of the steel company. Several more are being installed as rapidly as completed. Under regular service conditions, sixty wheels a day are being finished. In one hour the machine removes 528 pounds of metal. This machine receives the wheels just as they come from the rolling or forging operation. The tread and flange are rough-turned and finished and one side of the hub is faced, leaving only the operations of boring and facing the other side of the hub to be performed on another machine.

The machine actually handles the same number of wheels on the first operation mentioned that formerly required ten machines, so that the total number of machines required to accomplish complete machining on the same output of wheels is reduced 60 per cent.

The machine, while styled a "vertical car wheel lathe," partakes more of the character of a boring mill in that the table rotates in the horizontal plane. The frame is an extremely heavy casting, shaped like that of a boring mill around the base. There, however, the similarity ceases, as the frame swings in at the top to give support to the single heavy square vertical bar that carries the hub-facing tools. Two side heads which feed inward in a horizontal direction carry the tread-roughing and finishing tools respectively. The table is large enough to chuck 42-inch wheels and is driven by a gear with a 12-inch face.

Power feeds and traverse are supplied to both side heads and to the facing bar. All feeds are independent of each other and automatic trips disengage them at any predetermined point of travel. A pneumatically operated crane is built integral with the machine for handling the wheels on to and off the table. The machine is driven by a fifty-horsepower motor.

The Safety Bracket

A NEW invention of great value to painters and tinsmiths is a strong and durable safety bracket. The bracket, intended for use on ladders, is made of ductile steel and may be adjusted to any standard ladder. The safety bracket, as shown at the top of the page, holds the ladder away from a building 14 inches, allowing the surface underneath the ladder to be painted without moving it. When painting sashes, the sash can be raised or lowered at will without raising the ladder. Color pots when placed on the bracket are kept clear of the ladder and working surface, a safety clip on the bracket preventing pots from sliding against the finished surface.

The bracket enables the tinsmith to work easily on the inside of the gutter and take the gutter down or put it in place without reaching and without moving his ladder. The bracket may rest against the shingles, holding the ladder away from the gutter and enabling the tinsmith to work without fear of falling or having the wind blow his ladder over, as has often been the case where the ladder rested against the metal gutter.

Last Words of Science

Ingenious Devices at the Recent Meeting of the British Association for the Advancement of Science

By John B. C. Kershaw

THE Meeting of the British Association for the Advancement of Science which was held in Liverpool, England, from September 12th to 19th, was marked by one of the largest attendances (3,300) which has been registered in recent years, and by several new features that most probably will become permanent additions to the attractions of this annual gathering of scientists.

The two most notable of these were (1) the Exhibition of Scientific Instruments and Apparatus in the Central Technical School, which was kept open to the public for ten days, and (2) the Scientific Soirée of the university upon the last evening of the meeting (Tuesday, September 18th), when no fewer than 135 exhibits and 21 short illustrated lectures and demonstrations were planned for the instruction and entertainment of the visitors. Both of these new features were an unqualified success, and an attendance of 3500 was attracted to the university buildings on the night of the Soirée.

On the Monday afternoon many honorary degrees were conferred in the Arts Theater of the university, and among those upon whom the honor was conferred was Prof. G. N. Lewis, professor of chemistry in the University of California.

Abstracts of the presidential address, which dealt with the electrical structure of matter, and proved the atom to be a minute model of the solar system, with a minute nucleus of positive electricity in place of the sun, and negatively charged electrons in place of the planets, have already appeared in American technical journals. This article, therefore, will deal solely with the novelties shown at the Exhibition of Scientific Instruments referred to above, many of these being quite new to the general public.

The Frenophone is a friction-operated loud speaking telephone apparatus, in which amplification combined with great purity of reproduction is achieved, by utilizing the friction that occurs between surfaces of glass and cork. The instrument consists of an ordinary reed-type telephone earpiece receiver, in which a steel pin is soldered into the reed; a cork-faced steel pad on which the pin presses; a glass turntable driven by a clockwork motor; and a diaphragm at the base of a loud speaker trumpet.

The output from a Burndept wireless receiver is supplied to the telephone earpiece, in the usual manner. Speech vibrations set up in the reed travel along the pin, and are imparted to the cork-faced disc. The vibratory changes of pressure on the cork cause variations of the friction, between the pad and the surface of the revolving glass turntable, on which it lies. It is usual to treat the surface of the glass with a special preparation, in order to increase this frictional grip. As the friction varies with the speech vibrations, the pad is pulled more or less in the direction of rotation of the glass; and, by linking it to the center of a loud speaker diaphragm, the frictional pull produces speech in the trumpet, very greatly magnified.

The Photophone, as its name implies, conveys sound by means of light, and is the invention of Mr. A. O. Rankine. Mr. Rankine produced it during the War for the Admiralty, and its usefulness to the Navy is obvious. Verbal messages can be sent by this device from ship to ship with absolute secrecy; for an enemy attempting to tap the message would be obliged to take up a position between sender and receiver and would thus be visible to both.

In the instrument shown, the transmitter, or light modulator, was in St. George's Hall, whence the fluctuating light, concentrated into a narrow beam, proceeded to the receiver in Room 29 at the Central Technical School, where the transmitted speech was heard. The photo-electric cells used were selenium cells, made according to the design of Prof. H. Thorring of Vienna.

For demonstration purposes the speaker sat at a window of St. George's Hall, talking at a mirror. A V-shaped board rested on the window ledge, the apex pointing into the room. On one extremity stood a 500-candle-power electric globe, and opposite this was a large condensing lens, covered with a metal grid. Another similar lens stood by its side on the opposite arm of the board, and in front of them at the apex, was a phonograph diaphragm to which was attached a tiny mirror. This mirror received the light through the first condensing lens, and was so adjusted as to reflect the image of its grid upon the grid of the second lens. When the sender spoke into a trumpet to the diaphragm, the vibrations caused the little mirror also to vibrate, and this in turn caused the image of the first grid to vibrate on the second grid. In other words the amount of light passed through the second filter fluctuated as the voice vibrated the mirror.

Highly efficient instrument for assisting those with defective hearing, known as the Otophone

At the Technical Schools, 100 yards distant, quite a different apparatus was set up. This consisted of a kind of camera, with a huge lens facing the all-important window at St. George's Hall. The lens collected the vibrating rays of light sent out, and focused them on a plate of photo-electric cells (selenium), and thereafter the vibrations were translated back into the spoken words. Sunlight may be employed for this purpose, and the effectiveness of the Photophone is limited by one factor only, the fact that light travels in a straight line. The curvature of the earth, for example, would quite preclude the possibility of sending a light message below the horizon.

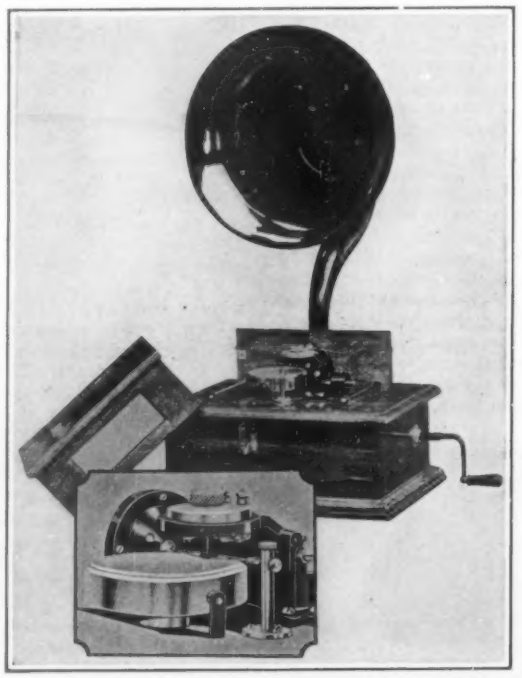
The Optophone is the invention of Dr. E. E. Fournier d'Albe of London, and has been modified and developed by Messrs. Barr & Stroud, Ltd., of Glasgow. Its purpose is to enable the blind to read ordinary printed matter, such as books or newspapers. This is accomplished by producing, in a telephone receiver, a series of musical notes which take their sound character from the shape of the letters, as they are passed over by the instrument in traversing a line of printing. Its construction and operation were described in these columns several years ago. Suffice it to say here that the instrument depends again for its action upon a remarkable property of the chemical element selenium, the electrical conductivity of which, in its grey crystalline form, varies greatly in accordance with the amount of light to which it is exposed. In the Optophone, a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of the letters which are passed over in traversing a line of printed type, each letter being indicated in the telephone by a characteristic motif, comprising successions of single notes and chords. Printed letters are thus translated into a sound alphabet, which can be readily learned.

The printed page to be read, is placed face downwards on a glass plate, supported on a suitable stand. Beneath the plate is a tablet of porcelain, pierced with an aperture to permit the passage of light upwards, and so through the glass on to the paper. The upper surface of the tablet around the aperture, is prepared as a sensitive selenium bridge, and is connected up to a battery and a telephone. The selenium bridge receives only light reflected from the page. The light used is obtained from a small straight-filament electric lamp, placed beneath a rotating disc perforated with small holes arranged in five concentric circles near its edge. The disc is kept in rapid rotation by motor.

Above the disc there is an optical system, which throws on to the paper an image of the lamp filament as it would be seen through the perforations in the disc. By this means the light that falls on the printed matter forms five bright spots in line, forming what is called the "scala." Each spot is pulsating at a rate corresponding to the number of holes in the circle of perforations to which it belongs, multiplied by the number of revolutions per second of the disc. There are 18 holes in the innermost circle, 24, 27, 30 and 36 in the other circles respectively, and if the disc makes 21⅓ revolutions per second, the second circle of holes will produce 512 pulsations of light per second, corresponding to the vibrations in the musical note C. The numbers of holes given above are in proportion to the vibrations in the notes G, C, D, E, G.

The spot of light corresponding to low G is caused to fall on the lowest points of such letters as j, p, y, etc., the high G falling on the tops of capitals and of the high letters. The three intermediate spots cover the height of the short letters.

Then there was the Otophone. This is the most efficient instrument yet produced for assisting those with defective hearing. It is the result of several years' careful investigation by the Marconi Research Department, and it embodies the latest developments in sound transmission and reception. By aid of this instrument, those who would otherwise hear nothing can clearly understand all that is said within many feet of the instrument, and can enter fully into the enjoyment of a lecture or entertainment. The Otophone also relieves a deaf person of that feeling of deficiency which usually accompanies deafness, and enables him or her to take part in a dinner-table or drawing-room conversation, with ease and comfort.



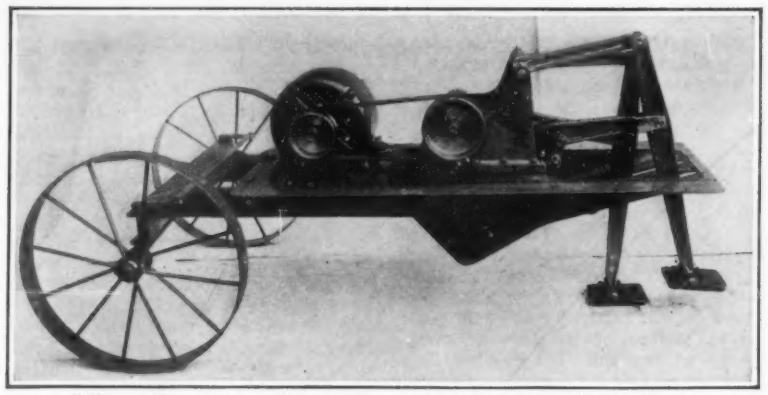
Friction-operated loud-speaking telephone utilizing friction between glass and cork, known as the Frenophone

Study of Quenching Mediums

THE object of a new investigation started by the Bureau of Standards is to obtain more complete information than is now available on the cooling properties of the ordinary quenching liquids used in the heat treatment of steel. It is also hoped that some information bearing on the subject of dimensional changes, occurring during the hardening of steel, will be obtained. The preliminary work has been devoted largely to setting up the necessary apparatus, but a few preliminary experiments have been carried out on quenching nickel cylinders in water with very satisfactory results, and as this work is now practically completed, it is hoped that rapid progress will be made on the main investigation.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



Still another tractor that walks—on its front legs, that is to say

The Walking Tractor

IN this day of scientific progress it looks as if we were going back to first principles or to imitate nature in many things. And the latest case to illustrate this is an invention of Fritz A. Nilsson, a mechanical engineer of Stockholm, Sweden. Mr. Nilsson has perfected a tractor which has been tried and tested by the Agricultural Department of the Swedish Government. It is called the Itus motor tractor, and it moves forward hauling a load without the use of driving wheels or caterpillar chains. In other words, the "Itus" is a walking tractor, using intermittently moving levers, or "legs," which retain a fixed grip in the ground.

The power from the motor is transmitted through planetary gear and segments, which produce a movement of these levers almost identical to that of a horse, when the animal is pulling a load. By thus imitating nature it is found that the weight of the tractor may be limited to the necessary weight of the motor and component parts of the apparatus, because the resistance of load against forward movements of this tractor will in an equal degree increase the grip of the lever-legs in the ground, and it is only necessary to provide shoes suited to the nature of the road or field on which the machine is to proceed.

The general design of the Itus motor tractor, when built for heavy services, consists of a platform, on which the motor is carried. The front end of the platform is mounted on a pair of light guide wheels. On the back of the platform two sets of planet gear boxes are mounted, each with a pair of levers extending underneath the platform as legs. The planet gear boxes are connected to the motor by differential gears in such a way that one pair of lever-legs can move forward more swiftly than the other, which will allow the "Itus" to travel in any desired curve with facility. The movement of the lever-legs is timed so that two legs are always planted on the ground before a leg is raised. As soon as the leg is lifted from the ground, the movement is uniformly accelerated, until the midway point of the curve is reached, where the speed is five times greater and then gradually decreases, until the leg reaches the ground again, where the speed is the same as at the beginning of the step. This movement is effected without cams, springs or chains by an ingenious direct gear-drive.

When a small tractor, such as is used on a small farm, or garden, is wanted, the inventor has designed such a one but this is equipped with only one planet gear-box and one pair of lever-legs. This type is adapted for pulling one plow and the driver walks behind it.

Water-motor attachment for beating and whipping

An Inexpensive Kitchen Servant

THE other day we saw a water motor advertised in the newspaper and having had sad experience with similar devices we bought one and tried it out in our domestic laboratory—the kitchen. This water motor is intended to lighten the tiresome process of beating and is entirely successful. It consists of metal casing adapted to be screwed to any standard threaded faucet as one would a garden hose. The water under pressure enters the casing, actuates the miniature turbine, and escapes by a spillway pipe at the side. In some cases, particularly in apartment houses, there is no thread on the faucet as there is no lawn to water. To make the motor usable in this instance, an adapter containing a rubber washer is provided. This adapter is secured to the faucet by three set-screws and our engraving was made in our photographic laboratory using the adapter. It worked beautifully, but not so when we tested it further at home. The bottom of the tap was not entirely round as was determined by a soap impression of the orifice, so another plan was adopted to prevent a leakage of the water and consequent reduction of pressure.

A second adapter was therefore bought for 50 cents and made the tap in reality a screw tap. This consisted of a small length of rubber hose secured to a threaded collar adapted to receive the rotating sleeve on the motor-casing. The rubber is shoved on the tap and is tightened by a band secured with a thumb-screw. In practice it was found quicker to apply this rubber on the faucet each time rather than to unscrew the motor. Any fruit jar of the so-called "Mason" variety will answer and we only have to screw the jar to the motor and push the rubber on the faucet, give one turn to the thumb screw and start the water flowing. The beating arms rotate at high speed and beat cream, eggs, pancake batter, mayonnaise, custard, malted milk, frosting or sauces. If the jar is not needed as in cake batter, a bowl answers perfectly well. If the Mason jar is broken another can be secured from the five and ten. A motor of this kind saves a great deal of drudgery and costs nothing unless you have a water meter and is even worth while in that case.

A Means for Increasing the Efficiency of Steam Radiators

FOR esthetic reasons, and also because it has become a custom, the radiators employed in heating buildings are usually painted with aluminum or bronze paint. From the viewpoint of obtaining the maximum amount of heat from a radiator of a given size, this is one of the most inefficient paints that can be applied. Tests in progress at the Bureau of Standards on the emissivity of sheet iron covered with white paint, enamel, and aluminum paint show that the aluminum paint emits only 27 to 30 per cent as much as a nonmetallic paint on enamel.

It has been generally known for some time that aluminum paint is not so good a radiator as a nonmetallic paint, some published data indicating that the emissivity of aluminum paint was about 75 per cent that of a nonmetallic paint, such as iron oxide. With increase in age and other deterioration, the surfaces used in the present test would increase in emissivity, but it is evident that for efficient service we should educate ourselves so as to become accustomed to the use of nonmetallic paints, such as the oxides of iron, chromium, white paint, etc., for metal radiators.

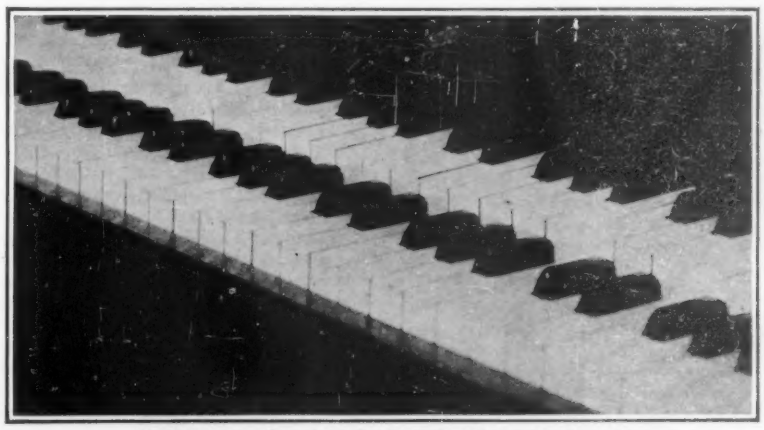
Ordinary rocker converted into a temporary wheel chair

A Wheel Chair from Any Rocker

FEW homes are free from invalids. The unexpected accident frequently makes it necessary for a wheel chair to be brought into the house. This invention has been brought out by an experienced nurse of Indianapolis, Indiana, to take the place of a cumbersome wheel chair when necessity demands. It makes any rocker a wheel chair in a very few minutes. Is attached by felt protected clamps to the rockers. The foot board is adjustable to suit the comfort of the user, and in every respect the invention provides a satisfactory invalid chair.

Is the Piano Keyboard Obsolete?

THERE are some things which have become so well established that it never occurs to the least conservative of us to study out a way to improve them. One of these is the keyboard of the piano. But Dr. Moritz Stoehr, the recent inventor of the device for transposing and recording music called the music typewriter, is not a conservative musician. Now he has come forward with another invention—an improved style of keyboard for the piano. Tests that have been made on this piano have shown that a musician can very readily adapt himself to the change. In one test a pianist of unusual ability sat down before the new piano without ever having seen one and played several intricate selections



Doubling up the piano keyboard to halve its length

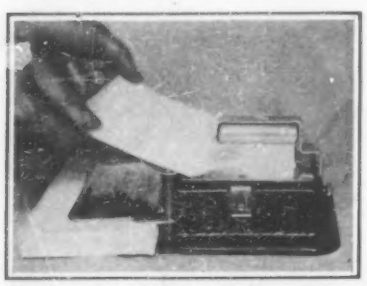
Fruit-jar sealing without paraffin or rubber rings

with the same facility as on the regular keyboard.

The new Mehlin keyboard is double. The inventor, whom we have already named, could see no reason why the keys of a piano need be so long. Observation of many musicians while playing the piano showed him that a few struck the keys near the fallboard, but most used only a small part of the key at the front. Hence, the result we see in the photograph. Diligent practice has had to make up for the fundamental defects in the regular keyboard, while the new reduction in size of the keys does not bring the fingers any closer together than in the case of stringed instruments. Dr. Stoehr, who lives in New York City, states that a keyboard of 39 by 5½ inches affords ample room for the player's fingers. Another advantage of this is that it affords two pianos in the space of one.

To Deal with Cling-stone Peaches

THE accompanying drawing shows an electrically driven pitting saw for cutting and removing stones from cling peaches. The device consists of a rapidly revolving saw, in front of which are two knives A and B. By means of the nuts shown at C, C, the upper knife is adjustable enabling it to be used on large or small peaches. The peaches are slipped on to these knives and moved forward toward the revolving saw. As the peaches are forced along between the two knives the fruit is cut almost into the stone. The operator keeps feeding the peaches in between the two knives which forces the forward peaches into the revolving saw, which cuts the stone completely in two, the two halves dropping out into proper receptacles. By means of the device shown in the man's hand at the right, the stones are then quickly removed from the peach halves. The device consists of a piece of steel with saw teeth as shown at G. This piece of steel is given a vibratory motion by means of an electric motor driving a flexible rod H. The operator picks up a half of a peach with the left hand, and removes the stone by using the steel with saw teeth like a spoon, passing the piece of steel around the half of the stone, the vibratory motion cutting the stone from the peach.



The envelope-sealing machine that is indifferent to the envelope's size or thickness

A Friction Seal for Fruit Jars

THE procedure of sealing fruit jars with paraffin or with rubber rings is familiar to every housewife, and doubtless few of them have suspected that there might be an easier or simpler way of preventing the entrance of air to the contents of the jar. We illustrate an outfit for which just this greater simplicity and ease is claimed—not to say a word about greater economy. When the tin cover is forced down tight, in some such way as illustrated, the double friction surfaces adjust themselves to one another in such a manner that leakage in either direction is impossible. To open, a screwdriver or similar instrument is used; and with ordinary care, it is stated that the same cover may be used repeatedly.

Telephone Silencer for Navy Use

A DEVICE known as the hush-a-phone, which has been successfully used in business offices, has recently been found of interest to officers of various Navy Departments, particularly of the United States and Great Britain.

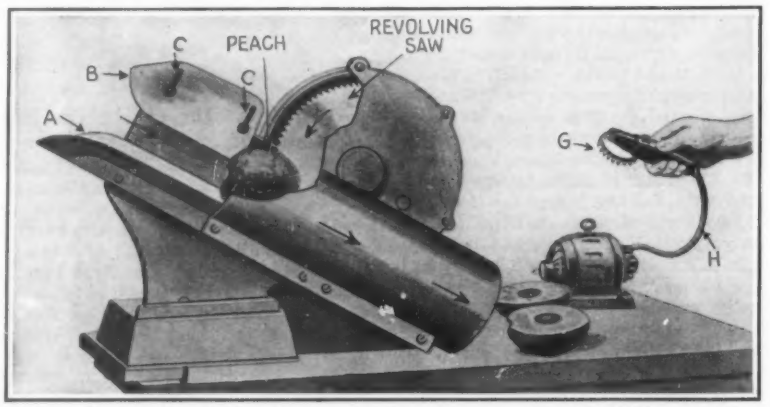
One advantage sought, is to enable control officers located in close proximity to be able to transmit firing data without disturbing each other. The effect being to talk as if in a quiet room instead of each contributing to the clamor of 'phone talk.

Another advantage gained, is that surrounding noises of machinery or gun fire is kept out of the transmitter, producing a more "quiet wire."

The improved hearing resulting from a quiet wire, increases the certitude of accuracy in transmitting firing data, being analagous to the commercial application where accuracy in transmitting orders for the buying or selling of stocks and bonds, quotations, train despatching and orders for merchandise, is secured by use of the hush-a-phone. Errors in this work are costly and their elimination productive of efficiency and economy.

One Machine to Lick All Envelopes

THE necessity for automatic sealing of envelopes is felt in every large office, but it has not always been found possible to get a single machine which, without tedious adjustment, would take all the sizes of envelope which a given office sends out. A new apparatus will seal an envelope of any over-all size and of any thickness, without adjustment. Its operating speed is 40 per minute. Proper tension between roller and moistening roll is secured by means of an adjustable bracket, the envelope to be sealed being drawn between the two. The sealed envelopes are stacked under a metal plate which is heavy enough to give the pressure needed to make the seal effective.



When the peach and the stone refuse to part company, this little machine demonstrates that indirection may sometimes be the shortest way around. It cuts the stone in half, and then frees the peach separately from each half.

Pen and Pencil in One

HERETOFORE we have been in the habit of carrying a fountain pen and in addition a mechanical pencil. Now ingenuity has developed a combination fountain pen and mechanical pencil. What we carried as two articles we can now put in the pocket as one. There will be some pocket unloading when the new device becomes generally known.

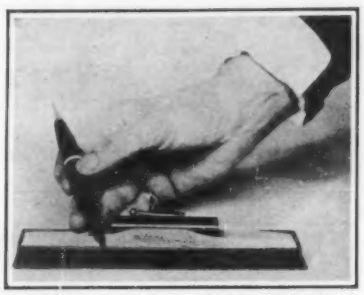
Thermal Opalescence in Crystals

IN a recent issue of *Nature*, Mr. C. V. Raman of Calcutta, describes experiments to determine the thermal opalescence in crystals and the color of ice in glaciers. If a block of clear ice, free from air-bubbles, striae, or other obvious inclusions, and having flat sides, be held squarely and a narrow pencil of sunlight concentrated by a lens be passed through it, the track of the pencil shows a beautiful blue opalescence. It is advisable not to use a very highly-condensed cone of rays, as this would cause internal melting of the ice with formation of cavities which reflect white light and distract the eye. A dark background should be provided against which the track may be viewed. With small or irregular lumps of ice, the observation may easily be made by immersing the ice in clear distilled water contained in a glass flask which is painted black outside, windows being provided for ingress and egress of light and for observation of the opalescent track. Even with ice which at first looks unpromising owing to internal flaws or inclusions, portions in which the blue opalescence is not overpowered by disturbing effects may be picked out. A suitable orientation of the block with reference to the direction of the incident rays is often useful in avoiding reflections from cavities in the ice.

The atomic scattering of light in block-ice demonstrated and measured in these experiments should certainly be capable of being observed on a large scale under suitable natural conditions. Indeed, it is well known that masses of ice in glaciers and icebergs often exhibit a blue color, and it appears to the writer very significant that the circumstances in which natural ice shows a blue color are precisely those found to be necessary in the laboratory in order that the blue opalescence due to internal scattering may be satisfactorily observed, that is, that the ice should be of the maximum clearness and transparency; in either case, air-bubbles, striae, and other inclusions obscure the effect sought for. The inference that the phenomena arise in the same way seems legitimate. A different explanation of the color of natural ice has been put forward by Tyndall and other writers, that is, that the color is simply an absorption effect. However, it appears that the latter view presents fundamental difficulties. *Prima facie*, no substance can exhibit color in its own body except as the result of internal diffusion or scattering. Color due to simple absorption can only be perceived when a luminous object is viewed through the substance, and even then it is the source, not the absorbing medium, that appears colored.

The absorption theory thus leaves it unexplained why clear ice should exhibit any color at all. Indeed, it would appear that the color of ice is often very conspicuously observed when the light traversing it has no chance of reaching the observer's eye directly. Thus, for example, in his lecture on ice and glaciers, Helmholtz describes very vividly the experience of the Alpine traveler who, traversing the broken surface of the glacier along a narrow ridge, looks down into the crevasses on either side and observes their dark blue walls going down to the depths. It is obvious that in such a case as this, the light filtering down into the solid mass of transparent ice forming the glacier through the superficial layers or otherwise, has no possibility of returning to the observer above save through internal scattering.

The natural view to take is, therefore, that the blue opalescence is the real cause of the color of transparent ice observed under such conditions, the absorption of light in traversing the medium tending merely to diminish its intensity and make it of a more saturated hue.

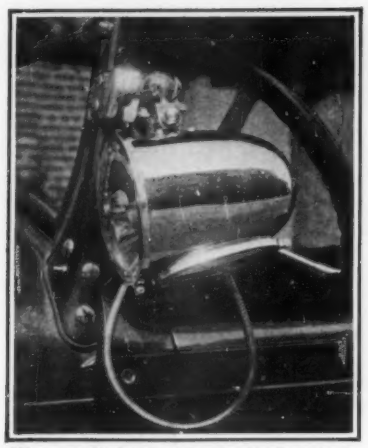


A single writing tool that plays the part of fountain pen and pencil

Safety Clamp for Wire Rope

FOR fastening wire rope a clamp with a U-bolt and self-tightening cam which cannot slip or crush the cable is now being manufactured. The clamp is applied square with the cable and tightened with a wrench. A feature of the device is the use of a grooved cam which serves the double purpose of protecting the cable from the concentrated pressure of the U-bolt and of providing an eccentric movement which causes it to increase its grip as the cable turns it under pressure. Only one clamp is required for each cable. The self-tightening feature automatically compensates for the shrinkage of the cable under load, and merely grips the tighter as the load increases.

Novel clamp that grips wire rope in a slip-less grip



The spotlight that keeps its beam at the side of the car

The Safety Spotlight

THE elongated lower lamp in this new spotlight floods the side of a car and the road over which it passes with a flood of light. This makes less dangerous the passing of another car on a dark country road.

Each light can be operated independently from a switch on the dash. With such a light there is protection for the driver of a car as well as the man approaching.

A Machine to Meet the Rabbit Plague

ONE WAY to deal with rabbits, the great Australian plague, is to dig up their burrows. This, however, is largely a loss of effort, for the rabbits reopen the burrows as fast as the workers can destroy them—if not faster. Mr. E. K. Bowman, of Wargundy, has invented an interesting apparatus that attacks the problem from the other side. He fills up the holes instead of digging them out, and he does this by machine. Roughly speaking, what he has is a tractor that carries two tanks, one of earth and one of water. The earth is kept replenished by a digging element attached to the machine. The earth from the one tank and the water from the other are mixed by a revolving concrete mixer, and passed down a chute, from which the mixture is directed into the burrows. After drying, this mixture sets like cement; and the animals make no effort to reopen the burrow.

An Angle Machine for Unusual Jobs

A LITTLE machine that can do a great deal of heavy work of an unusual nature is an angle and bar bending machine which has just been perfected. The machine is equipped with dies and gages which eliminate the necessity of laying off stock and make the production of duplicate angles and bends easy. It performs an unusual variety of work.

The new angle bender, and some of its work

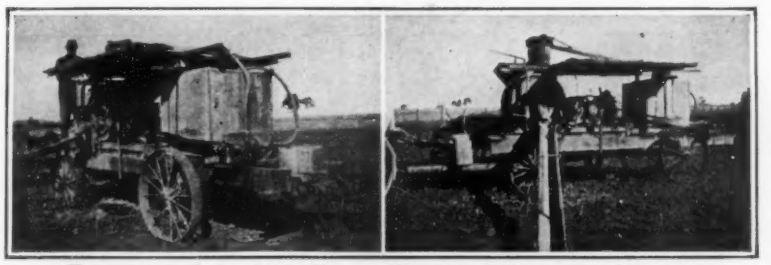
The bender will bend angles of any degree, round and flat stock; will bend angle iron after cutting V in wing of stock at bending point; will bend flat stock edgewise, and with U blocks will bend perfect U's and hooks. It has the following capacity: Bends flat stock hot up to 2 by ½ inches, rounds and squares up to ⅞ inches; bends flat stock cold up to 1½ by ¼ inches, rounds and squares up to ½ inch; bends flat stock hot 1¼ by ⅜ inches and under edgewise; bends angle iron up to 2 by 2 by ¼ inches by cutting V in wing at bending point.

Proper Steel for Automobile Bumpers

THE bumper of an automobile has not been ordinarily regarded as a portion of the car which should need incorporated in it any special grade of steel or any particular scientific attention. In many cases a properly bent strip of cold-rolled steel or even a piece of steel pipe has been used.

Considerable attention has been devoted to this part of the car recently. It has been found that, unless the bumper is of the proper material and properly heat-treated, harm to the car is likely to result. For example, if the bumper is too rigid, a collision may break the frame of the car and if it is too frail in resistance to a blow or impact, much damage may follow.

Recognizing these facts, automobile insurance companies are now specifying a bumper of steel or special material, worked or heat-treated so that the steel will meet certain specifications—made of a material which will pass certain impact or shock tests, closely approximating general or standard service conditions.



Two views of the Australian machine for filling rabbit burrows

The Uses of Radium

IT was early discovered that radium broke down successively into emanation, radium a, radium b, radium c and radium d, gaining equilibrium with these decay products in approximately thirty days. During this process of disintegration, three rays are given off—alpha, beta and gamma. The first has little penetrating power and is stopped by a sheet of paper. The second is more penetrating, while some of the third will penetrate ten inches of steel. Shortly after the discovery of radium it was found that the last two rays were destructive to certain kinds of cells and the medical use of radium in the treatment of various conditions is built around this susceptibility of the cell to the action of radium rays.

Many different conditions are treated by radium, including cancers and tumors, although radium is also used in much less serious conditions; for example, the removal of birthmarks, warts and tonsils.

At present extensive work is being done on cancer. Except in very advanced cases, this disease can be arrested, but the big problem is to prevent its recurrence. In case it does not recur in ten years, it can be considered to have been cured. Ten years, however, is a very long time for experimental purposes, and interesting experiments are now being carried on with mice and flies. If the disease does not occur in ten weeks in the case of mice, it has been eradicated, while in the case of flies, the time can be measured in days. Hence these experiments will shortly give knowledge which would require an exceedingly long time to acquire by the treatment of human beings.

Two general methods are being followed today in the use of radium in medicine. The first is the use of radium sulfate put up in needles, tubes and plaques. The needles most widely used are the 10 milligram non-corrosive steel needle having a diameter of 1.5 millimeters and a length of 29 millimeters (about the width of a pin head and a trifle longer than the ordinary pin), and the 5 milligram needle having the same diameter with half the length. The barrel of these needles is bored out to provide a radium chamber into which the radium is inserted. Asbestos packing is then placed next to the radium, the eye is inserted and then soldered into place.

In the treatment of disease these needles are buried directly in the affected tissue and left until the required radiation has been delivered.

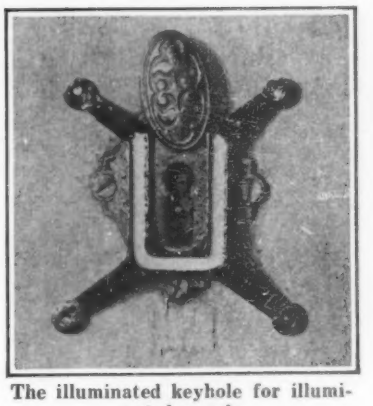
A second method is the use of radium emanation which is the first disintegration product of radium and a gas. This necessitates the use of a solution of some radium salt, preferably the bromide, which is unstable. The radium solution is usually placed in a closed container in a safe with a tube leading to a pumping and connecting apparatus, the gas being pumped off and collected in fine glass capillary tubes. These are sealed off by flame and imbedded in the tissue-like needles except that needles are extracted while the glass spicules are left in. The radioactivity in these spicules loses 16.5 per cent the first day, 16 per cent of the balance the second day, and so on, becoming entirely inactive in thirty days.

Shoes Shined for One Cent

MOST of us are familiar with the various "Penny-in-the-Slot" machines. We can now add to the number a machine which makes it unnecessary, it is claimed, to spend five or ten cents a day for a shoe shine which is not really needed except that the shoes need a dusting, and the wearer has scruples against using his handkerchief for the purpose, besides exerting what to some persons is too great a physical effort.

All one need do now is to drop a penny in an automatic shoe-brushing machine, place the foot beneath the rapidly revolving brush, and in half a minute the shoes are cleaned from mud and dust, and the original lustre of the dressed leather is restored. The brush, which revolves an ample length of time to thoroughly cleanse each shoe, is a specially made affair of the same type used at shoe factories in putting the final finish on shoes before shipment.

This machine will not shine a shoe that has nothing on it with which to work; but it will, however, keep Sunday's shine bright and clean for a surprising length of time, if used regularly.



The illuminated keyhole for illuminated people

The Self-Finding Keyhole

THE Amalgamated Association of Joke-smiths of America has not yet given official consideration to the question whether prohibition applies to its members; and until it does so, jokes which depend for their point upon the assumption that the hero—or the goat, in the more usual case—was slightly "jangled" are still within the law. In the present instance, we shall let each reader supply his own humor to go with the accompanying picture. The photograph in question depicts a recent German invention—the luminous keyhole. A rectangular frame around the hole, covered with radium paint, lends precision to the efforts of Heinrich Beerguzzler to bring about a connection between key and lock, and thus to get into his residence in the wee small hours without arousing the neighborhood. Theoretically the device is outlawed in America, but from the recent utterances of the Governor of at least one of our states, we judge that it might find considerable local applicability.

Rail Car Used in Building Dam

THE Georgia Railway & Power Company has one of the most complete and comprehensive plans for hydroelectric power development in the country. The first development was at the Tallulah Falls in 1913, then came the Mathis Reservor and the Burton Dam. The Tugalo Development Dam is about 400 feet below the point where the Chattooga and Tallulah Rivers unite to form the Tugalo. Two more developments are planned to come later. In order to build such an enormous dam and power house, approximately 1000 men moved to this site, forming quite a village with their

Saving yesterday's shine with a penny-in-the-slot machine

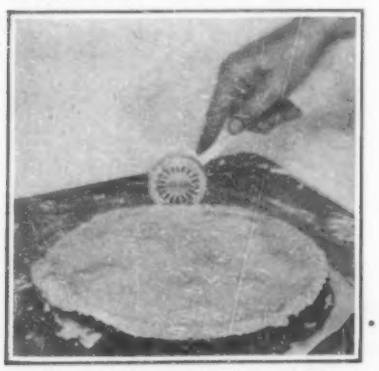
The trouble-shovel that is easily carried in the car

families. This site is about twelve miles from the main line of the Southern Railway and a standard-gage railway goes from the main line to the dam. At the junction point a station has been erected and named Tugalo. This is about six miles north of Toccoa.

The Georgia Railway & Power Company proved its progressiveness again by putting into service a rail motor-car on this stretch of track between Tugalo station and the dam. This truck is a 3½-ton of standard make equipped with a cab and a stake-and-rack body. The front of the truck is mounted on a four-wheel pivotal pony truck. The rear wheels are regular wooden truck wheels fitted with steel locomotive tires. The steering-gear of the truck is connected to the hand-brake rigging which acts on the front wheels. Thus the foot brake functions on the rear wheels while the steering-wheel applies the special brake on the front pony trucks. The truck hauls regular freight cars and flats equipped with seats to carry passengers plus freight. The track works its way through a very beautiful section of the country and the truck travels fully fourteen miles before reaching the dam site.

No More Juiceless Pies

THE old-fashioned housekeeper will recognize, in the attached picture, the modern version of an ancient device—the pie-crimping wheel. Mrs. Newlywed, on the other hand, may have to be told that the purpose of the little wheel on the end of the handle is to seal the two crusts of the pie together so that the juice remains where it belongs—inside the pie. The pronged wheel, as it is run around the edge of the pie, trims off at the same time all superfluous dough. The result is a pie that doesn't stick to the pie-plate, but does stick to the ribs of the happy consumer.



The latest pie-crimping wheel

A Spade for the Mired Car

FOR getting the stranded car out of the sand and mud, a shovel is sometimes the finest little tool imaginable. But carrying in the automobile a shovel that is more than a toy, presents its difficulties. One solution is illustrated herewith. This shovel is very far, indeed, from a toy; it is a regular spade, substantially made. The trick is that the size and the length of the handle are such as to enable it to be carried beneath the car seat without folding the handle. With an unbroken handle, much greater strength and greater digging efficiency are obtained. And, wrapped in its shipping bag and stowed beneath the seat, it travels without any rattle.

Three Guns for the Price of One

THE average sportsman returns with a gun weighing apparently ten times as much as it did at the start of the hunt. It is rather fortunate for him that there has been placed on the market a combination arm that can be dismantled in about one minute and distributed about his body, thereby lessening the dead weight of a complete gun.

This welcome weapon is a combination repeating rifle, target and small game pistol, and pocket pistol. The change from an accurate, well balanced pistol into a long range rifle is made by simply removing the 7½-inch pistol barrel and screwing into its place the 20-inch rifle barrel to which the forearm is already fixed. A butt stock is then attached by means of a single screw or bolt and the rifle is complete for effective work it is claimed at 450 yards range. The weapon is as easily changed into a pocket pistol by substituting a three-inch barrel. The slide on the receiver is fitted with a folding pistol and rifle sight. With the leaf laid down it is an open pistol sight of the navy type, and for use with the rifle the leaf is raised and the arm is then equipped with a peep sight adjustable for range by means of a slide. The bolt lock is easily depressed by the thumb of the operator, and drawing the bolt to the rear extracts and ejects the empty shell. By moving the bolt forward a cartridge is fed from the clip into the chamber, and in the same movement of the bolt the arm is cocked and ready for the next shot. It is said that there is one important feature which is particularly valuable when this weapon is used at the target range. The breech can be left open until the very moment of firing as it has a safety catch which, when it is raised, makes it impossible to discharge the arm or move the bolt, as the trigger is entirely disengaged. The manufacturers also claim that this arm has all the desirable features of a single shot weapon without the loss of power through the escape of gas true of revolvers and automatics.

The three-in-one-firearm, assembled for use as pocket pistol, rifle and target-and-game pistol

The Shock-Proof Accelerator Pedal

THE difficulty of keeping one's foot steadily on the gas on a rough road is claimed to be overcome in the accelerator of new design which we illustrate in the accompanying drawing. To feed the gas, the feed button is touched with a light pressure of the gas, and depressed until the desired speed has been gained. Then the foot is allowed to rest in a natural position on the foot treadle. Without exerting any pressure whatever, the weight of the foot alone on this treadle is sufficient to cause friction between the lower surface of the treadle and the friction shoe, and thus to hold the gas in the same position. The gas flow is retarded by allowing the foot to come back, as with the ordinary accelerator. The new pedal is applied in sizes suitable for all cars.

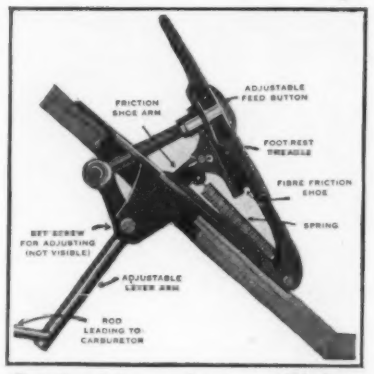
The Haber Process of Ammonia Synthesis

THE early experiments of Haber, like most of those which have served as the foundations of great industrial undertakings, were made with a purely scientific object, and with no technical applications in view. The results obtained, however, soon made it clear that the basis of an important technical process could be found in ammonia synthesis, and further work was undertaken with this end in sight.

In 1908 the Badische Gesellschaft placed at Haber's disposal all the means requisite for the further progress of the research on the synthesis of nitric oxide in the electric arc which he had begun in 1907, but his proposal to undertake research on the synthesis of ammonia was received with open doubts as to the potential value of the method. The nitric oxide synthesis, in cooled arcs under reduced pressure, and in flames and explosions, were not found suitable for technical application. The judgment of the technical chemists of the Badische Gesellschaft had been at fault, since ammonia synthesis was ultimately a very real solution of the problem of the economic utilization of atmospheric nitrogen.

Ramsay and Young in 1884 had found that with nitrogen and hydrogen in presence of iron at 800° centigrade, no ammonia was produced. This was found to be incorrect, and traces of ammonia were detected. Other catalysts were tried, and from the results it was evident that an equilibrium state was attained, from which it was possible to calculate the yields at other temperatures and pressures. No further progress was made, however, since it was judged by the technical experts to be impossible to carry out the reaction on the large scale at the temperatures required and under the very high pressures indicated by the calculations.

In 1906, measurements under pressure were for the first time carried out by Nernst and Jellinek, and in 1908, Haber in conjunction with Dr. Le Rossignol began experiments at higher pressures. The technical chemists were still unfavorably inclined towards the process, although practical yields had now been reached. By the use of new catalysts the temperature was lowered to 500-600° under a pressure of 200 atmospheres. In 1913, the process was taken up by the Badische Gesellschaft, but an account of the main scientific results was also published. The work of Dr. Bosch speedily led to the successful introduction of the synthetic ammonia process, and in the period 1913-1920 the capacities of the German factories rose from nothing at all to 1,500,000 tons per year.

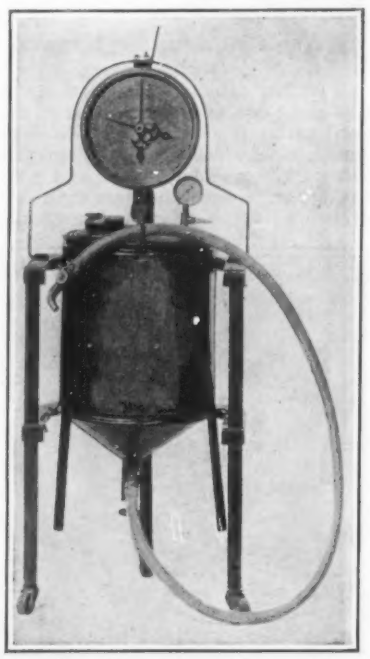


Details of the accelerator pedal that gives a rest for the foot

For Vending Grease and Oil

A NEW machine for the vending of thick oil and greases, especially to automobiles, is being put upon the market. It consists of an easily moveable frame supporting an inflatable container, or tank, holding about 50 pounds of lubricant upon a specially designed forward-and-backward registering scale which shows at once the totals and units contained and sold. This scale is fitted with a protecting release. From the bottom of the tank extends a hose ending in a special spring nozzle for safe delivery of contents to car or container.

The makers claim that the machine weighs all materials in and out exactly; that it is cleanly, easily movable and dirt-excluding; that it will deliver any specified amount of contents to any gear-box exactly, and will check up sales or contents at any time exactly.



An oil- and grease-vending machine that gives accurate measure

The Heavens in January, 1924

Some Facts and Some History About the Infant Class of the Solar System

By Professor Henry Norris Russell, Ph. D.

IN THE present state of astronomy, discoveries within our solar system are relatively rare, and circumscribed in their scope. All the greater worlds appear to have been already conquered, and those which remain to be found are so small that we can hardly call them "worlds" at all, though the title of planets we cannot deny them.

Of these little ones, enough and to spare are already known. Since Piazzi discovered Ceres, on the first day of the nineteenth century, the list of the asteroids has steadily grown—slowly at first, then faster, and finally, in the last three decades, by leaps and bounds, until the number of those whose orbits are known well enough to justify listing and naming them is close to a thousand.

In the old days of visual observation it was no easy matter to discover a new planet—though we know that there were plenty to be found. The observer had to make himself a chart of some likely region of the sky (along the ecliptic, near which all the larger planets lie), by weeks of labor; and then he had to go over this region again and again, looking for any faint star-like speck which was not upon his map, and which might then turn out to be a planetoid which had moved into the field since the year before.

But nowadays we apply the principle of scientific management. We work by machinery, and it might almost be said that certain astronomers engage in "quantity production" of asteroid discoveries. The method of this change is, of course, photographic. If we use a suitable lens, giving us good star images over a wide field of the sky, our chart, which is as necessary as ever, is made automatically for us in a couple of hours' exposure—and far more accurately and completely than could be done by the old method in a month's labor. Comparison of two plates, taken at different times, will reveal any planet which has invaded our field, and this comparison too can be made mechanically by the aid of that ingenious instrument, the blink microscope. Here we put the two plates into our apparatus, and so adjust them that the same region, as pictured on the one or the other, can be seen alternately by shifting a little mirror, without moving the eye from the eye-piece. Make this alternation of images rapid, and put the plates in their carriers so that the star-images in the two appear in the same position in the field of view: then the stars will appear fixed, while any object which has moved, or changed in brightness, between the two dates of exposure, will seem to flicker or "blink" in a very conspicuous fashion. To pick out a few such objects among ten thousand stars, or more, becomes then an easy matter.

Quantity Production of Asteroids

But the asteroid-hunter need not even go to the trouble of providing himself with this somewhat costly accessory. He can make the asteroid identify itself. All that is requisite is to prolong the exposure over several hours—guiding the while with an auxiliary telescope to make sure that the camera remains always pointed exactly right. The star-images are then round black dots upon the negative, while the moving asteroids appear as streaks, or trails. The off chance of mistaking a defect in the photograph for a planet may be eliminated by using a pair of cameras and photographing the region in duplicate.

Yet this device is imperfect; for the light of the stars, which we are not concerned with, is concentrated into sharp images on our plate, while that of the asteroids which we are hunting is spread out into a trail—so that the fainter ones may be lost. Better results can be obtained by adjusting the movement so that the camera follows, not the stars, but a point moving at the average rate at which an asteroid might be expected to shift its position. The stars will then be drawn out into trails and the planets will appear as dots (or as short trails if they are not moving quite at the estimated rate, or in the estimated direction).

In this way the discovery of these tiny bodies becomes a matter of routine. It is almost *too* easy to discover them—at least, many of those that are so found "get lost" again. To calculate an orbit, with whose aid we can relocate and reobserve the planet a year or two later, we must have observations—at least three in number—separated by a fortnight or so. Too often the moon comes around, fogging the plate with its light; or bad weather intervenes, and when the next good chance comes, the newly discovered planet can no longer be found—perhaps because we have not looked for it in the right place, perhaps because it has grown fainter.

The number of planets which have thus been found only to be lost again runs far into the hundreds. They are not *permanently* lost, though. Very often, when a good orbit can be calculated for a newly discovered planet, it is found, calculating backward, that it has been observed before (sometimes twice before) among the "lost" objects—and that the old observations can now be used to their full value.

Sometimes a planet gets away from us, even after it has been observed well enough to permit an orbit to be calculated. A first orbit, based on a few observations, is never very accurate. Small errors in the original measures are enormously magnified by the extrapolation to the next opposition, and the planet, when found again, is usually not *at* the predicted place, but *near* it. If, however, it is not picked up again for three or four years, this uncertainty may grow to such a degree that we are at a loss where to look, and may not pick it up at all.

Planetoidal Prodigals

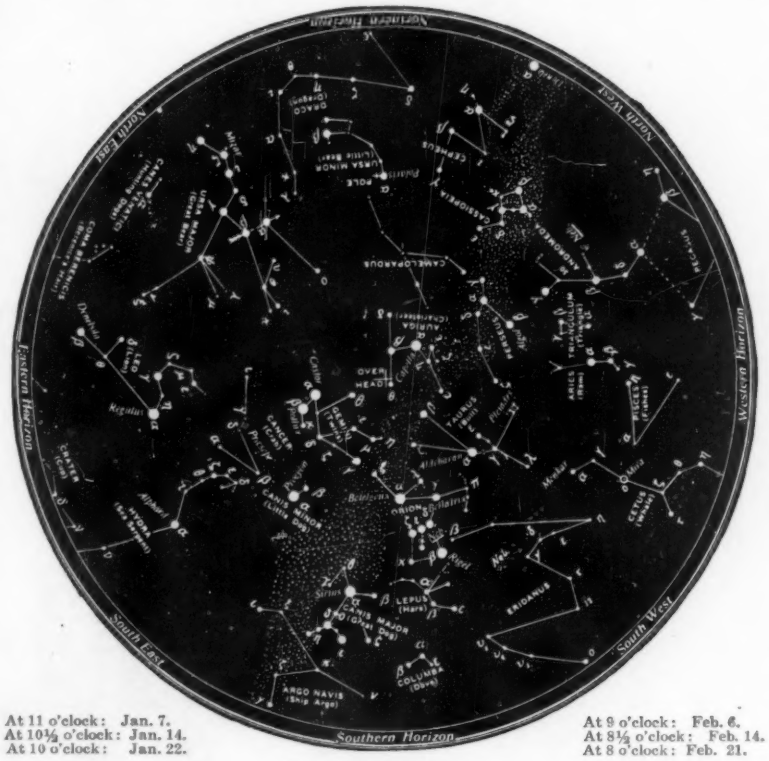
Several "lost" planets of this sort were found among the earlier discoveries, made by direct observation. One by one, however, they have been picked up again, unexpectedly, by the powerful modern means of discovery—their identity becoming known only when their orbits were computed afresh, and found to coincide with those of one or another of the lost planets. A particularly interesting case of this kind happened about a year ago.

Professor Watson, in the year 1873, discovered an asteroid of moderate brightness, for which he obtained observations covering three weeks' interval, and computed an orbit, and to which he gave the classical name Aethra. It was seen at once to be remarkable, on account of the great inclination of its orbit, nearly 25 degrees, and its great eccentricity, 0.38, which made its minimum distance from the sun less than half its maximum. At the next couple of observations the planet was not observed, probably because it was much farther from the sun, and fainter—and later it could not be found at all, and was put upon the "missing" list, where it remained for nearly forty years. Why this happened was shown clearly in 1916, by the calculations of Alter, who found that, by small changes in the observed positions, quite within the possible errors of observation, the calculated period might be changed by two or three months either way—enough to amount to a whole revolution since the discovery and loss of the planet. Nothing but a happy chance could find it again; and the chance happened in December, 1922.

At this time the asteroid came to perihelion when the earth was on the near side of the sun, and so looked brighter than it had for years—and it is a gratifying evidence of the efficiency of our astronomical patrols that it was discovered independently by three observers—in Russia, in Algiers and at Washington. A month or two later, when its orbit had been calculated, it became quite clear that it was following just the same path as the planet lost in 1873, and was indeed the missing Aethra. This rediscovery leaves no gap among the first two hundred asteroids to be discovered, all the lost ones being now returned to the fold.

Aethra itself is rather out of the usual run of these little planets. Its period is of average length—four years and one-fifth—and its average distance from the sun, 250 million miles, is not remarkable; but its great eccentricity brings it at perihelion within 155 million miles of the sun, and nearer than all but two or three of the thousand others; while its aphelion distance of 345 million miles is again exceeded by but a few. At a perihelion opposition—which we came close to having a year ago—it is but sixty million miles from the earth, and appears brighter than the ninth magnitude, which is pretty bright for an asteroid. At aphelion, even at opposition, it is fainter than the thirteenth magnitude. This is far from placing it out of reach of powerful instruments, once we know where to look for it, but explains why it was not picked up by chance until it came near her again. Its actual diameter may be roughly estimated at fifty miles—which is more or less like the general run of asteroids.

The planet has been well observed during the past year, and there is no danger of its getting lost again. Theoretical workers will have a fine time with it, both in calculating its orbit and in working out the perturbations due to attraction of the planets in the forty-year interval since its first discovery. The rather costly calculations involved can be financed in this case, for Professor Watson, who discovered about a dozen other asteroids, provided in his will for a trust fund to take care of future observations and calculations regarding them.



At 11 o'clock: Jan. 7.
At 10½ o'clock: Jan. 14.
At 10 o'clock: Jan. 22.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: Jan. 29.

NIGHT SKY: JANUARY AND FEBRUARY

The Planets

The star-map will have to stand on its own feet this month. Mercury is an evening star until the 12th and a morning star after that date, but is too near the sun to be seen except at the very beginning of the month and near its close. Venus, an evening star, is becoming conspicuous. She sets at 6:50 P. M. on the 1st and at 8 P. M. on the 31st, and is far brighter than anything else in sight. Mars is a morning star in Libra and Scorpio, rising about 3:15 A. M. in the middle of the month. Jupiter, too, is in Scorpio, about 15 degrees farther east, and rises an hour or so later. Saturn is in Virgo, and comes into quadrature west of the sun on the 23rd. Uranus is in Aquarius, setting at 9 P. M. in the middle of the month. Neptune, in Leo, is approaching opposition, and observable most of the night.

Gasoline Cars and Trucks of 1924

THE purpose of the accompanying chart of motor-car prices is to enable the man who knows approximately how much he can spend for a car to see at a glance what cars fall within the price-range which he has in mind. Sufficient data are given with reference to the engine and the chassis to indicate in a general way the size and power of the car; but these items are only incidental to the main purpose of the table. The arrangement of the chart is different from that which we have used for a similar purpose in past years, and will, we believe, make it easier to put the table to the purpose for which it is intended.

Under each of the major heads, "Two Cylinders," "Four Cylinders," etc., the entries are arranged strictly according to the price of the standard open model. This may be assumed to accommodate five passengers, unless the price is followed by the figure "4" or "7." In view of the very large place occupied in today's motor market by closed models, the price is also stated for the standard closed model, with the same convention regarding passenger-capacity. The entries in this column, however, necessarily are somewhat out of numerical order, since their arrangement must follow that of the open cars. In the final column, an attempt is made to indicate what other bodies than the standard "phaeton" (touring car) and sedan are offered. The abbreviations used in this column are: R. (roadster, speedster, etc.), C (coupe), B (brougham), Sp (sport models), S (sedan or similar closed models, aside from the standard sedan), 7 (seven-passenger open or closed models excluded from the two preceding columns by the presence there of five-passenger bodies), Lim (limousine). In some cases the number of bodies offered and the difficulty of classification are such that we have simply remarked "Various."

The data are for the better part supplied by the manufacturers. In cases where the maker has failed to respond to repeated request for the information, and where we are assured that the car is really on the market, we have compiled the missing data with the cooperation of *Motor World*. In such instances the name of the car is preceded by an asterisk (*). The information then given pertains to the model that was being marketed on November 22nd—which may be that of 1924 or that of 1923.

The prices and other data, even when supplied by the manufacturers, are, of course, subject to error and to change without notice.

To the reader searching for a luxury car it should be pointed out that the last six entries among the four-cylinder models are separated from their predecessors by a very wide price-margin, are of large size and power, and compete with six-cylinder cars of parallel price, rather than with the more reasonably priced fours. The man using the chart as his guide to the purchase of a first car will also observe that the more expensive of the ordinary fours and the less expensive of the sixes cover the same price-range, and that within this range both groups should be considered by a prospective purchaser.

PASSENGER CARS

TWO CYLINDERS

			S.A.E. Rating	Wheel-base	Tire Size	Prices, Standard Models—Open	Prices, Standard Models—Closed	Other Models
Hanover	Hanover, Pa.		9.8	90	28 x 3	$ 250—2	$....	None

FOUR CYLINDERS

Ford	Detroit	Planetary Tranmission	22.5	100	30 x 3½	380	685	R, C
Star	Lansing, Mich.		15.6	102	30 x 3½	490	785	R, C, Sp
Overland	Toledo, O.	Model "91"	19.6	100	30 x 3½	495	795	None
Chevrolet	Detroit		21.7	103	30 x 3½	495	795	R, C
*Gray	Detroit		21.0	100	30 x 3½	520	835	R, C, Sp
Metropolitan	Kansas City	Air-Cooled; Two Speeds	11.3	108	30 x 3½	600	700	None
Sterling	New London, Conn.		27.4	110	31 x 4	685	....	None
Overland	Toledo, O.	Model "92"	19.6	106	30 x 3½	695	....	None
Maxwell	Detroit		21.0	109	31 x 4	795	1195	Various
Dodge Bros.	Detroit		24.0	116	32 x 4	880	1250	S
Dort	Flint, Mich.		19.6	108	31 x 4	885	1350	R, C, Sp
Durant	New York		24.1	109	31 x 4	890	1365	Various
Nash	Kenosha, Wis.	Also Sixes	18.2	112	33 x 4	935	1445	Various
Buick	Flint, Mich.	Also Sixes	18.2	109	31 x 4	965	1495	C, R
National	Louisville, Ky.	Also Sixes	19.6	112	32 x 4	975	1175	C, Sp
Champion	Philadelphia		19.6	112	32 x 4	975	1295	None
Seneca	Fostoria, O.		22.3	112	31 x 4	985	....	R
Elcar	Elkhart, Ind.	Also Sixes	21.0	112	31 x 4	995	1425	B, Sp, S
Gardner	St. Louis		21.7	112	32 x 4	995	1445	Various
Bush	Chicago	Also Sixes	...	112	31 x 4	1065	1525	B
*Earl	Jackson, Mich.		18.9	112	32 x 4	1095	1595	R, C, Sp
Kelsey	Belleville, N. J.		21.0	112	32 x 4	1150	1450	None
Willys-Knight	Toledo, O.	Model "64"; Sleeve Valves	21.0	118	32 x 4	1175	1450	None
Hupmobile	Detroit		16.9	115	32 x 4	1175	1750	R, C, Sp
Moller	Hagerstown, M.		12.0	100	27 x 3½	1200	....	R
Willys-Knight	Toledo, O.	Model "67"; Sleeve Valves	21.0	124	32 x 4½	1325—7	1995—7	None
*Stearns-Knight	Cleveland	Sleeve Valves; Also Sixes	22.5	125	34 x 4½	1595	2195	Various
H. C. S.	Indianapolis	Also Sixes	22.5	120	32 x 4½	2250	....	None
*Stutz	Indianapolis	Also Sixes	30.6	130	32 x 4½	2790	3490	Various
Revere	Logansport, Ind.		30.6	131	32 x 4½	3200	4000	R, Sp
Roamer	Kalamazoo, Mich.	Also Sixes	28.9	126	32 x 4½	3485	4650	R, 7, Sp
*Rubay	Cleveland		12.1	118	32 x 4	....	5100	None
Brewster	Long Island City, N. Y.		25.6	125	32 x 4½	....	7500	Var, Closed

SIX CYLINDERS

Oldsmobile	Lansing, Mich.		18.2	110	31 x 4	750	1095	Various
Essex	Detroit	By Hudson Co.; New Six	16.0	110½	31 x 4	850	975	None
Sterling	New London, Conn.		29.0	114	33 x 4	850	985	None
Oakland	Pontiac, Mich.		18.9	113	31 x 4	945	1395	C
Columbia	Detroit	"Light Six"	23.4	115	31 x 4	995	1495	C, S, Sp
Studebaker	South Bend, Ind.	"Light Six"	23.5	112	31 x 4	995	1550	R, C
Dort	Flint, Mich.		23.4	115	31 x 4	1025	1465	R, C, Sp
Cleveland	Cleveland		22.6	112	31 x 4	1045	1365	Various
Jewett	Detroit	By Paige Co.	25.4	112	31 x 4	1065	1495	R, C, Sp
Auburn	Auburn, Ind.	Model "6-43"	24.4	114	31 x 4	1095	1595	C, Sp
*Chalmers	Detroit	By Maxwell Co.; Short Models.	25.4	117	32 x 4	1185	1535	Sp
Flint	Flint, Mich.		27.3	120	32 x 4½	1195	1985	R, C, Sp
Anderson	Rock Hill, S. C.	Model "41"	23.4	115	32 x 4	1195	1695	Various
Nash	Kenosha, Wis.	Short Models; Also Fours	25.4	121	33 x 4	1240	2040	Various
Velie	Moline, Ill.		24.4	118	32 x 4	1275	1895	Various
Hudson	Detroit		29.6	126	34 x 4½	1295	1375	7, S, etc.
Stephens	Freeport, Ill.	Model "10"	25.3	117	32 x 4	1295	1595	R, S, Sp
Buick	Flint, Mich.	Short Model; Also Fours	27.3	120	32 x 4	1295	1695	R, S
Moon	St. Louis	Model "6-40"	23.4	115	31 x 4	1295	1695	R, C, Sp
Davis	Richmond, Ind.		23.4	115	31 x 4	1295	1795	B
Haynes	Kokomo, Ind.		29.4	121	32 x 4½	1295	1895	R, S, Sp
*Courier	Sandusky, O.		23.4	116	32 x 4	1295	1895—7	Various
*Chalmers	Detroit	By Maxwell Co.; Long Models	25.4	122	32 x 4	1295—7	2095—7	None
Reo	Lansing, Mich.		24.3	120	{32 x 4 {33 x 4½	1335	 1985	Sp C, B
Studebaker	South Bend, Ind.	"Special Six"	29.4	119	32 x 4	1350	2050	R, C
*Paterson	Flint, Mich.		27.3	120	32 x 4½	1390	2395	R, C, Sp 7
Barley	Kalamazoo, Mich.	By Roamer Co.	23.4	118	32 x 4	1395	1850	S, Sp
Elcar	Elkhart, Ind.	Also Fours	27.3	118	32 x 4	1395	1995	S, B, Sp
Huffman	Elkhart, Ind.		27.3	120	32 x 4	1395	2295	R, Sp
Bush	Chicago	Also Fours	...	118	32 x 4	1445	....	None
Chandler	Cleveland	New gear-shift; see page 7	29.4	123	{32 x 4 {33 x 4½	1485	 1785	R, 7, Sp 7, Lim
Beggs	Kansas City		...	120	33 x 4	1495	....	None
Moon	St. Louis	Models "6-50"	23.4	118	31 x 4	1495	1885	R, C, Sp
Hanson	Atlanta, Ga.		27.3	121	32 x 4	1495	1995	None
Bour-Davis	Shreveport, La.		29.0	126	33 x 4½	1500	....	7
Columbia	Detroit	"Big Six"	27.3	115	32 x 4	....	1995	C
Apperson	Kokomo, Ind.	Also Eights	24.0	120	32 x 4	1535	2200	None

Buick	Flint, Mich.	Long Model; Also Fours	27.3	128	32 x 4½	1565—7	2285—7	Various
Kissel	Hartford, Wis.		26.3	121	32 x 4	1585	2585	Various
Westcott	Springfield, O.		27.4	120	32 x 4½	1590	2490	B, Sp
Kline	Richmond, Va.		27.5	121	33 x 4	1590	2590	C, Sp
Stephens	Freeport, Ill.	Model "20"	25.3	124	33 x 4½	1595—7	2250—7	Sp
Auburn	Auburn, Ind.	Model "6-63"	25.4	122	32 x 4½	1595	2345	B, Sp
Anderson	Rock Hill, S. C.	Model "50"	27.3	122	32 x 4	1595—7	....	None
*Rickenbacker	Detroit		23.4	117	32 x 4	1635	2135	None
*Jordan	Cleveland	Model "MX"	26.3	120	32 x 4	1675	2285	R, C
*Pilot	Richmond, Ind.		25.4	126	32 x 4½	1695	2495	Various
Studebaker	South Bend, Ind.	"Big Six"	36.2	126	33 x 4½	1750	2750	R, C
Hatfield	Sidney, N. Y.		25.4	121	32 x 4	1775	....	None
			...	...	33 x 4½	....	2275	S
Moon	St. Louis	Model "6-58"	27.3	128	32 x 4½	1785—7	2485—7	S, Sp
*American	Plainfield, N. J.		29.4	127	33 x 4½	1785	2485	Various
*Washington	Eaton, O.		27.3	116	32 x 4	1785	....	None
*Case	Racine, Wis.	Model "X"	27.3	122	32 x 4½	1790	2575	R, C, Sp
*Lexington	Connersville, Ind.		25.4	123	32 x 4½	1795	2345	Various
Kurtz	Cleveland		...	122	33 x 4½	1845	2350	None
Franklin	Syracuse, N. Y.	Air-Cooled	25.3	115	32 x 4	1950	2850	Various
Sterling-Knight	Warren, O.	Sleeve Valves	25.4	125	32 x 4½	1985	2800	B, Sp
*Stutz	Indianapolis	Also Fours	27.3	120	32 x 4	1995	2550	R, Sp
*Jordan	Cleveland	Models "H, L"	26.3	124½	32 x 4½	1995	2585	None
R & V-Knight	East Moline, Ill.	Sleeve Valves	29.4	124	32 x 4½	2300	3050	C, 7, Sp
National	Indianapolis	Also Fours	29.4	130	32 x 4½	2375—7	3250—4	R, C, 7
*Stearns-Knight	Cleveland	Also Fours	27.3	130	34 x 4½	2395	3395	Various
Paige	Detroit		33.8	131	33 x 4½	2450	3235	7, B, Lim
*Case	Racine, Wis.	Model "Y"	31.5	132	33 x 5	2475—7	3325—7	None
Packard	Detroit	Model "126"; Also Eights	27.3	126	38 x 4½	2485	3275	Various
Holmes	Canton, O.	Air-Cooled	29.4	126	34 x 4½	2500—7	3000—7	C, R, S
*Noma	New York		27.3	128	33 x 5	2500—4	3500—5	R, 7
Premier	Indianapolis		27.3	126¾	32 x 4½	2585	3585	R, B, 7
H. C. S.	Indianapolis	Also Fours	29.4	126	32 x 4½	2650	3350	None
Packard	Detroit	Model "133"; Also Eights	27.3	133	33 x 4½	2685—7	3525—7	Various
Roamer	Kalamazoo, Mich.	Short Model; Also Fours	29.4	126	32 x 4½	2685	3585	Various
Marmon	Indianapolis		33.8	136	{32 x 4½ / 33 x 5	2785—4, 7 /	.... / 3985—5	Various / Various
Fox	Philadelphia	Air-Cooled	27.3	132	32 x 4½	2975	3975	C
Crawford	Hagerstown, Md.		31.5	138	33 x 5	3100	4500	None
Crawford-Dagmar	Hagerstown, Md.		31.5	138	33 x 5	3500	4500	Sp
Winton	Cleveland		33.8	132	33 x 5	3600	4250	Various
Mercer	Trenton, N. J.	Short Models	33.8	115	32 x 4½	3750	....	None
Roamer	Kalamazoo, Mich.	Long Model; Also Fours	29.4	138	32 x 4½	3950	4250	None
Mercer	Trenton, N. J.	Long Models	33.8	132	33 x 5	....	4700—7	Sp
Dorris	St. Louis		38.4	132	33 x 5	4150	5500	C, 7
Wasp	Bennington, Vt.		31.5	144	33 x 5	4500—4	....	None
Pierce-Arrow	Buffalo		38.4	138	33 x 5	5250—4, 7	6900—4	Various
McFarlan	Connersville, Ind.		48.6	140	33 x 5	5600	6600	Various
Stevens-Duryea	Chicopee Falls, Mass.		47.0	138	{33 x 5 / 35 x 5	7500—7 /	.... / 9675—7	Various / Various
Locomobile	Bridgeport		48.6	142	35 x 5	....	7900	Var. closed
*Rolls-Royce	Springfield, Mass.		48.6	143½	33 x 5	10900	12800	Various
		EIGHT CYLINDERS						
*King	Detroit	Model "LL"	28.8	120	32 x 4½	1595	1995	Various
*King	Detroit	Model "L"	28.8	124	32 x 4½	1795	2295	Various
Cole	Indianapolis		39.2	127¼	33 x 5	2175	3075	C
Wills Ste. Claire	Marysville, Mich.		33.0	127	32 x 4½	2475—7	3475—7	Sp
Standard	Butler, Pa.		33.8	127	34 x 4½	2500	3400	None
Peerless	Cleveland		33.8	128	33 x 5	2690	3690	None
Apperson	Kokomo, Ind.	Also Sixes	33.8	130	33 x 5	2800	3750	None
Cadillac	Detroit		31.3	132	32 x 5	2985	3950	Various
Packard	Detroit	Model 136; Straight Eight	36.4	136	33 x 5	3650	4650	R, C, Lim
Lincoln	Detroit	By Ford Co.	36.4	136	33 x 5	3800—4, 7	4700	Various
Packard	Detroit	Model "143"; Straight Eight	36.4	143	33 x 5	3850—7	4900—7	Lim
Lafayette	Milwaukee		33.8	132	33 x 5	5000	6300	R, 7
Cunningham	Rochester, N. Y.	Open Model	45.0	132	33 x 5	6200	....	Various
Duesenberg	Indianapolis	Straight Eight	26.5	134	33 x 5	6250	7800	Various
Cunningham	Rochester, N. Y.	Closed Models	45.0	142	33 x 5	....	7600	Various

COMMERCIAL VEHICLE

We have been unable satisfactorily to classify these trucks, speed-wagons, etc., into several groups, according to their tonnage ratings. The ambiguity of many ratings (1½-2 tons, 2½-3, etc., etc.), and the degree to which these ambiguous ratings overlap each other and overlap any limits which might be set for the several groups, makes such an attempt out of the question. We have finally concluded that the average truck-buyer using this list as a guide will feel that the price he can pay lies within more rigid limits than does the capacity of the vehicle which he requires; and that therefore the best ends will be served by a single list, in which all commercial vehicles will be entered in the order of their price. Attention is called to the unpriced trucks of numerous makes listed at the end.

Practically all truck manufacturers put out vehicles of various capacities, and so will be found at various points in the list. No attempt at cross-references is made in this connection. Those trucks which are made in but one model are indicated by a dagger (†). Some prices are for chassis only and others include cabs, etc.; but we have not this information in enough cases to attempt its inclusion.

Ford	Detroit	1	22.5	$ 370†
Overland	Toledo	½	19.6	395†
*Star	Lansing, Mich.	¾	15.6	405†
Chevrolet	Detroit	½	21.7	495
Chevrolet	Detroit	1	21.7	550
*Gray	Detroit	1	...	575
*Dort	Flint, Mich.	½	19.6	685†
Ruggles	Saginaw	¾	19.6	795
Champion	Philadelphia	½	...	895†
Dodge	Detroit	¾	24.0	895†
*Vim	Philadelphia	½-¾	25.6	995†
Oldsmobile	Lansing, Mich.	1	...	1095†
Stewart	Buffalo	1	22.5	1095
*Maxwell	Detroit	1½	21.0	1097†
Sullivan	Rochester, N. Y.	1	22.5	1100
Kearns	Danville, Pa.	1	19.6	1150
Reo	Lansing, Mich.	1½	...	1185
Perfection	Minneapolis	¾	19.6	1245
Ruggles	Saginaw, Mich.	1½	25.6	1245
Corbitt	Henderson, N. C.	¾	19.6	1250
Graham Bros.	Detroit	1	24.0	1265
Triangle	St. Johns, Mich.	1	19.6	1285
Roadking	Flint, Mich.	1½	25.6	1295†
Graham Bros.	Detroit	1½	24.0	1325
Standard	Detroit	1¼	22.5	1330
Wilson	Detroit	1	25.2	1350
Patriot	Havelock, Neb.	1	22.5	1350
Gramm-Pioneer	Lima, O.	1¼	22.5	1365
Bethlehem	Allentown, Pa.	1	19.6	1385
Noble	Kendallville, Ind.	1	22.5	1395
Parker	Milwaukee	1	22.5	1400
*Bessemer	Philadelphia	1	19.6	1450
All-American	Fremont, O.	1	19.6	1465
Corbitt	Henderson, N. C.	1	22.5	1480
Denby	Detroit	1¼	22.5	1485
Master	Chicago	1¼	22.5	1490
Duplex	Lansing, Mich.	1	22.5	1495
Bell	Ottumwa, Ia.	1	22.5	1495
Stewart	Buffalo	1¼-1½	22.5	1495
L. M. C.	Shreveport, La.	2½	...	1500†
Belmont	Lewistown, Pa.	1	22.0	1525
Perfection	Minneapolis	1¼	22.5	1545
Pioneer	Chicago	1	22.5	1550†
Kissel	Hartford, Wis.	1	...	1585
Garford	Lima, O.	1	21.0	1590
*Nash	Kenosha, Wis.	1-1½	...	1595
Watson	Canastota, N. Y.	1	22.4	1600†
*Dearborn	Chicago	1	...	1600
Henderson Bros.	Cambridge, Mass.	¾	...	1650
K-Z	Chicago	¾	22.5	1650
G. W. W.	Henderson, Ia.	1-1½	...	1650†
Kearns	Danville, Pa.	1½	19.6	1650
D-Olt	Woodhaven, N. Y.	1	19.5	1695
Gotfredson	Detroit	1	22.5	1695
Sandow	Chicago H'ts, Ill.	1	19.6	1695
Standard	Detroit	1½	22.5	1695
Huffman	Elkhart, Ind.	1½	22.5	1695
Traffic	St. Louis	2	22.5	1695
Gramm-Pioneer	Lima, O.	1½	22.5	1700
Traffic	St. Louis	1½	22.5	1750
O K	Okay, Okla.	1½	22.5	1750
*Gary	Gary, Ind.	1	...	1775
Clydesdale	Clyde, O.	¾-1¼	22.5	1785
Larrabee	Binghamton, N. Y.	1¼	27.3	1785
Velie	Moline, Ill.	1½-2	22.5	1785†
Huffman	Elkhart, Ind.	1½-2	22.5	1795
Moreland	Burbank, Cal.	1	25.6	1800
Kankakee	Kankakee, Ill.	1½	22.5	1800
Wisconsin	Madison, Wis.	1½	22.5	1850
Betz	Hammond, Ind.	1	22.5	1850
Hurlburt	Harrisburg, Pa.	1	22.5	1850
Dart	Waterloo, Ia.	1½	22.0	1850
D-Olt	Woodhaven, N. Y.	2	21.0	1850
Stewart	Buffalo	1½-2	22.5	1870
U. S.	Cincinnati	1¼	22.5	1875
Eagle	St. Louis	1-1½	22.5	1875
Noble	Kendallville, Ind.	1½	22.5	1890
Sandow	Chicago H'ts, Ill.	1½	22.5	1895
Ruggles	Saginaw, Mich.	2	25.6	1895
Wilcox Trux	Minneapolis	1	22.0	1900
Krebs	Bellevue, O.	1	22.5	1900
Maccar	Scranton, Pa.	1-1½	25.6	1900
All-American	Fremont, O.	1½	19.6	1915
K-Z	Chicago, Ill.	1	22.5	1950
Columbia	Pontiac, Mich.	1½	...	1950
Rainier	Flushing, N. Y.	¾	22.5	1970
Kissel	Hartford, Wis.	1½	...	1975
Keystone	Oaks, Pa.	2	22.5	1975†
*Dearborn	Chicago	1½	...	1980
Duplex	Lansing, Mich.	1½	22.5	1985
Triangle	St. Johns, Mich.	1½	22.5	1985
*Bessemer	Philadelphia	1½	22.5	1995
Henderson Bros.	Cambridge, Mass.	1	...	2000
O K.	Okay, Okla.	1½-2	25.6	2000
Bell	Ottumwa, Ia.	1½	22.5	2100
*Tiffin	Tiffin, O.	1½-2	27.2	2100
Traffic	St. Louis	3	22.5	2145
Rainier	Flushing, N. Y.	1	22.5	2150
Concord	Concord, N. H.	1	22.0	2150
Parker	Milwaukee	1½	25.6	2150
Rumely	La Porte, Ind.	1½-2	22.5	2150†
*Nash	Kenosha, Wis.	2-2½	...	2150
Corbitt	Henderson, N. C.	1½	22.5	2170
Gramm-Pioneer	Lima, O.	1½	22.5	2175
Bethlehem	Allentown, Pa.	2	25.6	2185
Autocar	Ardmore, Pa.	1½-2	18.0	2200
Kearns	Danville, Pa.	2	25.6	2200
U. S.	Cincinnati	1½	22.5	2225
Hal-Fur	Cleveland	1	25.6	2250
Kenworth	Seattle	1	22.5	2250
Available	Chicago	1¼	26.4	2250
Henderson Bros.	Cambridge, Mass.	1½	...	2250
*Nash	Kenosha, Wis.	2½	...	2250
Wilson	Detroit	1½	22.5	2270
K-Z	Chicago	1½	22.5	2275
Triangle	St. Johns, Mich.	2	22.5	2285
Ruggles	Saginaw	2½	25.6	2295
All-American	Fremont, O.	2-2½	19.6	2345
Clydesdale	Clyde, O.	1-1½	22.5	2350
Moreland	Burbank, Cal.	1½	25.6	2350

*Dependable	E. St. Louis, Ill.	1½-2	..	2350
Garford	Lima, O.	1½	22.5	2375
Selden	R'ch'st'r, N. Y.	1½-2½	22.5	2375
Denby	Detroit	2	22.5	2375
*Traylor	Allentown, Pa.	1½	...	2390
*Dearborn	Chicago	2	...	2390
Eagle	St. Louis	2-3	25.6	2395
White	Cleveland	¾	22.5	2400
Wachusett	Fitchburg, Mass.	1	27.3	2400
Gotfredson	Detroit	1½	25.6	2400
Patriot	Havelock, Neb.	2	25.6	2400
Twin City	Minneapolis	2	25.6	2400
D-Olt	Woodhaven, N. Y.	2½	24.0	2400
Duplex	Lansing, Mich.	2	26.5	2445
Available	Chicago	1½	26.4	2450
*Gary	Gary, Ind.	2	...	2450
Columbia	Pontiac, Mich.	2½	...	2460
Larrabee	B'gh'ton, N. Y.	1½-2¼	27.3	2465
Atterbury	Buffalo	1½-2	22.5	2475
Dorris	St. Louis	1	25.6	2490
Sullivan	Rochester, N. Y.	1½	22.5	2500
Schacht	Cincinnati	1½	25.6	2500
Brinton	Philadelphia	1½	25.0	2500
Walker-Johnson	Woburn, Mass.	1½	22.0	2500
Hurlburt	Harrisburg, Pa.	1½-2	29.0	2500
*Hendrickson	Chicago	1½	...	2525
U S	Cincinnati	2	22.5	2525
Wilcox Trux	Minneapolis	1½-2	29.0	2550
Armleder	Cincinnati	1½-2½	25.6	2550
Bell	Ottumwa, Ia.	2½	28.7	2550
Belmont	Lewistown, Pa.	2	28.9	2575
Corbitt	Henderson, N. C.	2	27.5	2585
Master	Chicago	1½	27.2	2590
Rainier	Flushing, N. Y.	1½-2	22.5	2590
Kankakee	Kankakee, Ill.	2½	27.2	2590
Stewart	Buffalo	2½-3	29.0	2590
Traffic	St. Louis	4	22.5	2595
Krebs	Bellevue, O.	1½	27.2	2600
Hal-Fur	Cleveland	1½	25.6	2600
Ace	Newark, O.	1½	22.0	2600
Concord	Concord, N. H.	1½	22.0	2600
Harvey	Harvey, Ill.	2	28.9	2650
Clydesdale	Clyde, O.	2-2½	27.2	2650
Gramm-Pioneer	Lima, O.	2½	27.2	2650
Perfection	Minneapolis	2½	27.2	2650
Noble	Kendallville, Ind.	2	22.5	2690
Huffman	Elkhart, Ind.	2½-3	28.9	2695
*Titan	Milwaukee	2½	...	2700
Wisconsin	Madison, Wis.	2	27.2	2700
*Tiffin	Tiffin, O.	2½-3	...	2700
Kalamazoo	Kalamazoo, Mich.	1½	22.0	2750
De Martini	San Francisco	1½	22.0	2750
Buffalo	Clarence, N. Y.	2	25.6	2750
Available	Chicago	2	26.4	2750
*Nash	Kenosha, Wis.	2-2½	...	2750
Sandow	Chicago H'ts, Ill.	2½	27.2	2750
Triangle	St. Johns, Mich.	2½	25.6	2785
Standard	Detroit	2½-3½	27.2	2795
Front Drive	B'nt'n H'b'r, Mich.	1½	22.5	2800
Wachusett	Fitchburg, Mass.	1½	22.5	2800
Dart	Waterloo, Ia.	2½	27.7	2800
Oneida	Green Bay	1¾	25.6	2825
Wilson	Detroit	2½	27.2	2825
Moreland	Burbank, Cal.	2	27.2	2850
*Traylor	Allentown, Pa.	2	...	2850
*Gary	Gary, Ind.	2½	...	2850
Krebs	Bellevue, O.	2½	32.4	2850
Selden	Rochester, N. Y.	1½-2½	27.2	2875
Kissel	Hartford, Wis.	2½	...	2875
K-Z	Chicago	2½	27.2	2875
Acason	Detroit	2	25.6	2890
*Bessemer	Philadelphia	2½	...	2895
Maccar	Scranton, Pa.	1½	25.6	2900
Harvey	Harvey, Ill.	2½	28.9	2950
O K	Okay, Okla.	2½-3	28.9	2950
*Dependable	Chicago	2½-3	...	2950
Columbia	Pontiac, Mich.	3	...	2950
Corbitt	Henderson, N. C.	2½	27.5	2970
Duplex	Lansing, Mich.	2½	26.5	2975
Sullivan	Rochester, N. Y.	2½	28.9	2975
Clydesdale	Clyde, O.	2½-3½	27.2	2975
Denby	Detroit	3	27.2	2975
Oshkosh	Oshkosh, Wis.	2	25.6	2985
Betz	Hammond, Ind.	2½	29.0	2985
Bethlehem	Allentown, Pa.	3	25.6	2985
*Rowe	Lancaster, Pa.	1½	...	3000
Mack	New York	1½	25.6	3000
Fageol	Oakland, Cal.	1½-2	22.5	3000
Parker	Milwaukee	2	25.6	3000
Witt-Will	Washington	2	27.2	3000
Wilcox Trux	Minneapolis	2½	29.0	3000
Patriot	Havelock, Neb.	3	32.4	3000
Rainier	Flushing, N. Y.	2-2½	27.2	3090
Kenworth	Seattle	1½	25.6	3100
Autocar	Ardmore, Pa.	2-3	25.6	3100
Wisconsin	Madison, Wis.	3	32.4	3100
Union	Bay City, Mich.	2½	25.6	3150
Noble	Kendallville, Ind.	2½	28.9	3150
Hurlburt	Harrisburg, Pa.	2½-3	29.0	3150
Armleder	Cincinnati	2½-3½	28.9	3150
Available	Chicago	2½	26.4	3160
Gotfredson	Detroit	2½	28.9	3175
Corbitt	Hend's'n, N. C.	2½-3	32.4	3195
White	Cleveland	¾	28.9	3200
Schacht	Cincinnati	2	25.6	3200
Wachusett	Fitchburg, Mass.	2	27.2	3200
*Hendrickson	Chicago	2½	...	3200
Oneida	Green Bay, Wis.	2½	25.6	3200
Olympic	Tacoma, Wash.	2½	28.0	3200†
D-Olt	Woodhaven, N. Y.	3½	31.0	3200
Sterling	Milwaukee	1½	30.6	3240
Garford	Lima, O.	1½ or 2½	29.0	3250
White	Cleveland	2	22.5	3250
Ultimate	Hillside, N. J.	2	28.9	3250
Concord	Concord, N. H.	2	25.6	3250
Ace	Newark, O.	2 or 2½	32.0	3250
De Martini	San Francisco	2-2½	29.0	3250
American	Portland, Conn.	2½	...	3250
Hal-Fur	Cleveland	2½	28.9	3250
Selden	Rochester, N. Y.	2½-3½	27.2	3250
Witt-Will	Washington	3	27.2	3250
Master	Chicago	2½	28.9	3290
Ward-La France	Elmira, N. Y.	2½-3½	...	3290
*Rowe	Lancaster, Pa.	2	...	3300
Pierce-Arrow	Buffalo	2	25.6	3300
Northwestern	Seattle	2	27.8	3300
Mack	New York	2	28.9	3300
Northway	Natick, Mass.	2-3	24.5	3300
Super-Truck	Waukegan, Ill.	2½	25.6	3300
Clydesdale	Clyde, O.	2½-3½	32.4	3300
*Traylor	Allentown, Pa.	3	...	3300
Gramm-Pioneer	Lima, O.	3	28.9	3300
Acason	Detroit	3	25.6	3350
Atterbury	Buffalo	2½-3	27.2	3375
U. S.	Cincinnati	3	25.6	3375
Dorris	St. Louis	2-2½	28.9	3400
Schacht	Cincinnati	2½	28.9	3400
Mack	New York	2½	28.9	3400
Sterling	Milwaukee	2	30.6	3440
Stewart	Buffalo	3½-4	32.4	3440
Mack	New York	1½	25.6	3450
Parker	Milwaukee	2½	28.9	3450
Lange	Pittsburgh	2½	27.2	3450
Buffalo	Clarence, N. Y.	3	25.6	3475
*Bessemer	Philadelphia	4	...	3495
Old Reliable	Chicago	2½	28.9	3500
Wilcox Trux	Minneapolis	2½	29.0	3500
Kalamazoo	Kalamazoo, Mich.	2½	30.0	3500
Northwestern	Seattle	2½	32.4	3500
Pierce-Arrow	Buffalo	3	25.6	3500
Belmont	Lewistown, Pa.	3	32.4	3500
Moreland	Burbank, Cal.	3	32.4	3500
Twin City	Minneapolis	3½	29.0	3500
Duplex	Lansing, Mich.	3½	29.2	3500
Rainier	Flushing, N. Y.	2½-3	27.2	3550
Selden	Rochester	2½-3½	32.4	3550
Larrabee	Binghamton	2½-3½	32.4	3550
Krebs	Bellevue, O.	3½	32.4	3550
Concord	Concord, N. H.	2½-3	28.6	3600
Maccar	Scranton, Pa.	3	28.9	3600
Walker-Johnson	Woburn, Mass.	3	28.9	3600
*Titan	Milwaukee	3½	...	3600
*Tiffin	Tiffin, O.	3½-4	...	3600
K-Z	Chicago	3½	32.4	3625
Standard	Detroit	3½-5	32.2	3645
Kissel	Hartford, Wis.	4	...	3675
Wilson	Detroit	3½	32.4	3685
Denby	Detroit	4	32.4	3695
Concord	Concord, N. H.	2	28.6	3700
Sterling	Milwaukee	2½	36.7	3700
*Hendrickson	Chicago	3½	...	3725
Mack	New York	2	28.9	3750
Kenworth	Seattle	2½	28.9	3750
Garford	Lima, O.	2½	32.4	3750
Ultimate	Hillside, N. J.	3	28.9	3750
Corbitt	Hend'son, N.C.	3½-4	32.4	3780
*Gary	Gary, Ind.	3½	...	3790
Wachusett	Fitchburg, Mass.	2½	32.4	3800
*Traylor	Allentown, Pa.	3	...	3800
Schacht	Cincinnati	3	28.9	3800
Ace	Newark, O.	3	40.0	3800
Mack	New York	2½	28.9	3850
Noble	Kendallville, Ind.	3½	32.4	3850
Krebs	Bellevue, O.	3½	36.1	3850
Gramm-Pioneer	Lima, O.	4	32.4	3850
Oshkosh	Oshkosh, Wis.	2½	25.6	3885
Sandow	Chicago H'ts, Ill.	3½	32.4	3895
Fageol	Oakland, Cal.	2½-3	30.6	3900
American-La Fr'ce	Elmira, N. Y.	2½	28.9	3950
Wilcox Trux	Minneapolis	3½	32.4	3950
Harvey	Harvey, Ill.	3½	32.4	3950
O K	Okay, Okla.	3½-4	32.4	3950
Union	Bay City, Mich.	4	28.9	3950
Sullivan	Rochester, N. Y.	3½	32.4	3975
Clydesdale	Clyde, O.	3½-5	32.4	3975
Kalamazoo	Kalamazoo, Mich.	3½	35.0	4000
Double Drive	Benton Harbor	4	32.4	4000
White	Cleveland	2	28.9	4050
Oneida	Green Bay, Wis.	3½	32.4	4050
U S	Cincinnati	4	32.4	4075
Doane	San Francisco	2½	31.0	4100
Larrabee	Binghamton	3½-4½	32.4	4100
*Titan	Milwaukee	5	...	4100
*Rowe	Lancaster, Pa.	3	...	4150
Super-Truck	Waukegan, Ill.	3½	28.9	4150
Hurlburt	Harrisburg, Pa.	3½-4	32.0	4150
Acason	Detroit	4	30.6	4150
Armleder	Cincinnati	3½-5	32.4	4150
Available	Chicago	3½	32.4	4175
Selden	Rochester	3½-5	32.4	4175
Gotfredson	Detroit	4	32.4	4175
Master	Chicago	3½	32.4	4190
F W D	Clintonville, Wis.	3	36.0	4200†
White	Cleveland	3½	28.9	4200
Northway	Natick, Mass.	3½-5	24.5	4200
Clydesdale	Clyde, O.	3½-5	36.1	4200
Garford	Lima, O.	4	32.4	4200
Autocar	Ardmore, Pa.	4-6	28.9	4200
De Martini	San Francisco	3-3½	29.0	4250
Hal-Fur	Cleveland	3½	32.4	4250
Old Reliable	Chicago	3½	32.4	4250
Corbitt	Henderson, N. C.	5	36.9	4250
Atterbury	Buffalo	3½-4	32.4	4275
American	Portland, Ct.	4	...	4275
Ward-La France	Elmira, N. Y.	3½-5	...	4290
Parker	Milwaukee	3½	32.4	4300
*Tiffin	Tiffin, O.	5-6	...	4300
Wilcox Trux	Minneapolis	5	36.2	4350
Dorris	St. Louis	3½	28.9	4400
Rainier	Flushing, N. Y.	3½-5	32.4	4400
Schacht	Cincinnati	4	32.4	4400
Lange	Pittsburgh	3½	32.4	4450
Maccar	Scranton, Pa.	4	32.4	4450
Gramm-Pioneer	Lima, O.	5	36.1	4450
*Gary	Gary, Ind.	5	...	4450
Selden	Rochester	3½-5	36.1	4475
Master	Chicago	5	32.4	4490
Standard	Detroit	5	36.4	4495
Kenworth	Seattle	3½	32.4	4500
*Rowe	Lancaster, Pa.	4	...	4500
Perfection	Minneapolis	4½	36.1	4500
White	Cleveland	5	28.9	4500
U S	Cincinnati	5	32.4	4500
Perfection	Minneapolis	5	36.1	4500
Super-Truck	Waukegan, Ill.	5	36.1	4500
American	Portland, Ct.	5	...	4500
Old Reliable	Chicago	5	36.1	4500
Sandow	Chicago H'ts, Ill.	5	37.5	4500
Kalamazoo	Kalamazoo, Mich.	5	40.0	4500
Hurlburt	Harrisburg, Pa.	5-5½	32.0	4500
Clydesdale	Clyde, O.	5-7	36.1	4500
*Tiffin	Tiffin, O.	6-7	...	4500
Wilson	Detroit	5-7	36.1	4520
Witt-Will	Washington, D. C.	5	45.0	4550
Wisconsin	Madison, Wis.	3½	36.1	4600
Pierce-Arrow	Buffalo	4	32.4	4600
Schacht	Cincinnati	5	32.4	4600
Moreland	Burbank, Cal.	5	36.1	4600
K-Z	Chicago	5	36.1	4625
Three-Point	New York	6	28.9	4650†
Pierce-Arrow	Buffalo	5	32.4	4700
*Traylor	Allentown, Pa.	5	...	4700
*Hendrickson	Chicago	6	...	4725
Sterling	Milwaukee	3½	42.1	4750
Denby	Detroit	5	36.1	4750
Gotfredson	Detroit	5	40.0	4775
De Martini	San Francisco	4-5	32.0	4850
*Rowe	Lancaster, Pa.	5	...	4850
D-Olt	Woodhaven, N. Y.	5	43.0	4890
Ward-La France	Elmira, N. Y.	5-7	...	4890
Amer.-La France	Elmira, N. Y.	3½	28.9	4950
Mack	New York	3½	40.0	4950
Selden	Rochester	5-7	36.1	4950
Atterbury	Buffalo	5-6	36.1	4975
Fageol	Oakland, Cal.	3½-4	32.4	5000
Garford	Lima, O.	5	40.0	5000
U S	Cincinnati	7	36.1	5000
Doane	San Francisco	3½	31.0	5100
Pierce-Arrow	Buffalo	6	32.4	5100
Rainier	Flushing, N. Y.	6-7	36.1	5100
Maccar	Scranton, Pa.	5	40.0	5200
Pierce-Arrow	Buffalo	7½	32.4	5200
Parker	Milwaukee	5	40.0	5250
Master	Chicago	5	36.1	5290
Available	Chicago	5	40.0	5375
Sterling	Milwaukee	5	52.1	5400
Amer-La France	Elmira, N. Y.	5	36.2	5500
Ultimate	Hillside, N. J.	5	40.0	5500
Mack	New York	5	40.0	5500
Super-Truck	Waukegan, Ill.	7½	40.0	5500
Fageol	Oakland, Cal.	5-6	32.4	5700
Mack	New York	6½	40.0	5750
Sterling	Milwaukee	5	42.1	5750
Doane	San Francisco	6	40.0	6000
Old Reliable	Chicago	7½	36.1	6000
Mack	New York	7½	40.0	6000
MacDonald	San Francisco	5-6	25.0	6300
Sterling	Milwaukee	7½	52.1	6500
MacDonald	San Francisco	7½-15	32.0	8000

Trucks of the following ratings and S. A. E. horsepower are offered by the manufacturers indicated, under a policy of quoting prices on application only from a prospective purchaser. We are therefore unable to list these in their proper places in the table above.

Acme: Cadillac, Mich.
1 (22.5), 1½ (22.5), 2 (22.5), 2 (27.2), 3 (27.2), 3 (32.4), 4½ (36.1), 6 (36.1)

Brockway: Cortland, N. Y.
1 (25.6), 1½-2 (25.6), 2½-3 (27.2), 3½-5 (32.4), 5-7 (36.1)

Chicago: Chicago
1½ (25.6), 2½ (25.6), 3 (32.4), 3½ (32.4), 5 (32.4)

*Commerce: Detroit
¾-1½, 1½, 2½

*Day-Elder: Newark, N. J.
1½, 2, 2½, 3, 4, 5-6

Diamond T.: Chicago
¼-1 (25.6), 1 (22.5), 1½ (22.5), 2½ (25.6), 3½ (28.9, 5 (32.4), 5 (36.0)

Federal: Detroit
1 (22.5), 1½ (22.5), 2½ (27.2), 3½-4 (32.4), 5-6 (36.1)

Fulton: Farmingdale, N. Y.
1-1½ (22.5), 2-2½ (22.5)

G. M. C.: Pontiac, Mich.
1 (19.6), 2 (25.6), 3½ (32.4), 5 (32.4)

Hahn: Hamburg, Pa.
1 (25.6), 1½ (25.6), 2 (27.2), 2½ (27.2), 3 (32.4), 5 (32.4), 6 (36.1)

Indiana: Marion, Ind.
1, 1½-2, 2, 2½-3, 3½-4, 5-7

International: Chicago
1 (19.6), 1½ (22.5), 2 (22.5), 3 (28.9), 5 (28.9)

Kelly-Springfield: Springfield, O.
1½ (24.0), 2½ (24.0), 3½ (32.4), 3½-5 (32.4), 5-7 (32.4)

Menominee: Clintonville, Wis.
1 (26.5), 1½ (26.5), 1½ (26.5), 2-2½ (26.5), 3½ (32.0), 5 (36.0)

Ogden: Chicago
1, 1½, 2½, 3½, 5

Republic: Alma, Mich.
1¼ (22.5), 2 (22.5), 3 (25.6), 3 (27.2), 4½ (32.4)

Sanford: Syracuse, N. Y.
1½-2 (22.4), 2½-3½ (27.2), 3½-5 (32.4), 5-7 (32.4)
Six cylinders: ¾-1½ (27.3), 1½-2 (27.3)

Service: Wabash, Ind.
1¼ (22.5), 1½ (25.6), 2 (28.9), 3 (28.9), 4 (32.4), 6 (32.4)

Signal: Detroit
1¾ (22.5), 2½ (27.2), 3½ (27.2), 5 (32.4), 7½ (36.1)

Transport: Mt. Pleasant, Mich.
1 (22.5), 1½ (22.5), 2 (25.6), 3½ (28.9), 5 (32.5)

*United: Grand Rapids, Mich.
¾, 1½, 2, 2½, 3½

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

GLIDER.—W. INHELDER, 58 W. 92d St., New York, N. Y. Among the objects of this invention is to produce a motorless heavier-than-air machine which is so constructed as to permit of the carrying of an operator and the maintenance of the machine in flight for an appreciable length of time by the utilization of air currents. A further object is to provide manually adjustable wings constituting climbing surfaces and a foot actuated elevation controlling rudder, whereby the operator may readily control the machine after a take-off. (See Fig. 1.)

Pertaining to Apparel

BRASSIERE.—I. PANES, c/o Star Brassiere Co., 30 W. 15th St., New York, N. Y. The invention relates to a combined brassiere and camisole, and has for its object to present a construction wherein the garment may be quickly and easily applied or removed by the person using the device. A further object is to provide a brassiere having an opening near the front and a plurality of securing members together with a flap for presenting a continuous smooth surface over the fastening members at the front of the garment.

FASTENING DEVICE FOR CUFFS.—A. L. THORNTON, Box 559, El Paso, Texas. The object of the invention is to provide a fastening device which cannot be accidentally detached from the cuff although adapted to be easily applied to or detached from the cuff by the person using the device. The device is simple yet ornamental and attractive in appearance, it is also durable and may be easily manufactured.

Chemical Processes

CARBURANT FOR ALCOHOL.—J. M. A. CHEVALIER, P. BOURCET and H. REGNAULT, c/o J. M. L. Chevalier, 11 Rue de Mademoiselle, Versailles, Seine-et-Oise. The invention relates to a process of carburation of alcohol, the object of which is to furnish the alcohol with volatile products rich in carbon and capable of imparting to it a calorific power comparable to that of petroleum benzine. The process is characterized by the addition to the alcohol of volatile oil of resin of a mean density of 0.890 and a light oil of acetone.

Electrical Devices

REFLECTOR AND LAMP SUPPORT.—R. S. BRADLEY, 256 S. Bunker Hill Ave., Los Angeles, Cal. The invention relates to lighting fixtures. An object is to provide a support for a reflector and incandescent lamp, which will permit of the lamp and reflector being adjusted to various positions whereby the light from the lamp may be utilized at various angles to best advantage. The support is simple in construction, easy to manufacture and very effective in carrying out its purpose. (See Fig. 2.)

CALLING DEVICE.—W. L. WHIDDEN, Box 75, Morgan Hill, Cal. This invention relates to calling devices for telephone exchanges and is designed principally for small telephone exchanges, such as private branch or the 40 drop camp boards used by the United States Government. The object is to substitute for the dry batteries used for ringing or calling an induction coil, utilizing its alternating high-voltage current for ringing the bell, thereby saving from 48 to 60 batteries.

MOTOR-DRIVEN CIRCUIT CARRIAGE.—S. H. SHARPSTEEN, Tenafly, N. J. The invention relates to electrical distribution, and particularly to means for distributing the same through a traveling member to a second traveling member, and has for its object to provide a construction wherein the electric current may be supplied in any quantity at a minimum cost over a maximum area. By this invention of universal circuit carriage, current may be distributed for railroad use, canal navigation, stone quarries, lumbering and agricultural purposes, with an arrangement whereby the vehicle utilizing the current is permitted movement in any direction.

ELECTRIC IRON.—J. LEWISKY and A. HEDTRICH, c/o C. W. Froessel, 931 Broadway, Brooklyn, N. Y. An object of the invention is to provide means whereby an electric iron can be mounted on a stand and when disposed thereon in a particular position will receive heating current, but when disposed in a different position will not receive the heating current. A further object is to provide a stand with which electrical mechanism is associated for automatically turning on the current.

DRY-CELL PRIMARY BATTERY.—W. S. DOE, c/o Doe Electrical Device Co., Day and Water Sts., Kent, O. Among the objects of the invention is to provide a dry-cell primary battery arranged to permit the user to readily replace a used-up cell by a new one, and to revive the battery, in case its energy is run down, by merely adding water to one of the dry-cell elements. The battery is particularly serviceable for use in portable flash lamps or hearing devices.

THERMOSTATIC SWITCHING DEVICE FOR ELECTRIC IRONS.—F. JERMIN, c/o N. M. Eddy, Alpena, Mich. The main object of this invention resides in the provision of a thermostatically operated switch constructed to open and break the electric circuit at a predetermined temperature, and means combined therewith to prevent the switch from being closed again until the iron has cooled by a definite amount. Another object resides in constructing the switch in such manner that it may be at any time released manually.

Of Interest to Farmers

METHOD OF AND APPARATUS FOR SUPPLYING WATER TO IRRIGATION DITCHES.—G. T. PETERS, Columbus, New Mexico. The object of the invention is to provide a method and apparatus of the character described whereby an adequate and uniform supply of water may be had from the water-bearing sand of a river bed, at all times, irrespective of flood or drought, a conduit leading to the irrigation ditch to supply the water.

MUZZLE.—C. M. RASMUSSEN, Box 34, Deschutes, Ore. An object of the invention is to provide a light weight muzzle with adjustable means for controlling the grazing activity of an animal, so that the quantity of grass or other vegetation accessible to the animal varies as required during different seasons and under different conditions, so that the animal may be prevented from eating excessive quantities and the consequent "bloating." The device when in position does not chafe or interfere with the movement of the animal's jaws.

HARVESTER FRAME CONSTRUCTION.—M. D. KAST, 616 Calvin St., Pendleton, Ore. An object of the invention is to provide a frame construction which permits a proper leveling of the frame regardless of the angle or side hill inclination, and which maintains the wheels in a vertical position and the frame relatively low to the ground and at the same distance from the ground at all leveling positions. This frame permits of a proper leveling either on flat ground or on the hillsides or inclining surfaces.

Of General Interest

ANT TRAP.—J. W. POLLOCK, Soldiers' Home, Sawtelle, Cal. The invention relates particularly to a trap designed for catching ants, an object being to provide a trap of this character from which an insect cannot escape, and designed in such a manner that ants or other insects are induced to enter. A further object is to provide a trap which will be simple, practical, easy to clean and inexpensive to manufacture.

COMBINED STORM SASH AND WINDOW SCREEN.—B. F. LADUE, 802 Duryea St., Raymond, Wash. It is the object of this invention to combine with a window screen a storm sash which will prevent rain coming through the screen, and thus enable the windows to be always open and screened during a storm. It is also an object that the combined sash and screen be adapted to be easily positioned in the runway of the lower window sash. (See Fig 3.)

STATISTICAL RECORD AND FILING DEVICE.—F. W. WOGLOM, 151 Beach St., Arlington, N. J. It is the aim of this invention to provide a statistical record and filing system whereby a complete and accurate record of all transactions between a manufacturer and a customer, together with the nature of the article, etc., may be kept. It is a further object to provide means by which an entry clerk may keep the record complete and up to date. It is not necessary for him to make different entries in different ledgers, the folder comprising record sheets for indexing merchandise bought and sold, summary and recapitulation, thus saving a great amount of bookkeeping. (See Fig 4.)

CLAY SHINGLE BLOCK AND WALL CONSTRUCTION.—A. HARDONCOURT, JR., 103 Park Ave., New York, N. Y. The invention has for its object to provide a building unit of clay, preferably formed hollow and also formed as an interlocking block,

HOW MAY A PATENT BE OBTAINED?

ALL proceedings in the Patent Office, the ministerial department of the Government created for the purpose of carrying into effect the right of protection of inventions given by the Constitution, are governed by the provisions of the Revised Statutes. Where the latter do not specifically control, the Rules of the Patent Office itself apply. To obtain a patent the inventor, or if he is deceased, his executor or administrator, must make application to the Patent Office in the form prescribed. The application consists of a petition to the Commissioner of Patents praying for the grant of a patent, a written specification of the invention, an oath regarding the applicant's inventorship, in most cases a drawing, and more rarely the application is accompanied by the deposit of a model or of specimens. The application must also be accompanied by the payment of the Patent Office fee. The actual scope of the invention, of which the patent affords a monopoly, is defined by the claims forming part of the specification. A patent claim is the definition in words of the actual patentable invention in question. It is probably the one most difficult expression in the English language to formulate. It must be clear, terse and precise. It must not be too limited and it must not be too broad. As a general proposition, the shorter a claim, the broader its scope, for it must be remembered that every patent claim must be considered in its entirety and, therefore, every element or feature included therein is a definite limitation. That a patent may disclose far more than is actually patented therein will be readily understood when it is considered that in order to make clear the actual and specific advance in the art involved in the invention, it may be necessary to show it in combination with a great deal more that is already old in that art. The progress of an application through the Patent Office, its so-called prosecution before the tribunals of the Office, is often a complicated one. The Patent Office Examiner cites as prior art the nearest references in the form of issued patents or other publications, rejecting some or all of the claims originally presented. Thereupon the applicant has opportunity to present new claims, to modify those already before the Office, or otherwise to correct and amend the application until finally the applicant and the Examiner are in accord as to the scope of the invention which may be patented. As much of this procedure is hedged about with technical considerations, rules and regulations, it is most essential that the application be prosecuted by one thoroughly skilled and experienced.

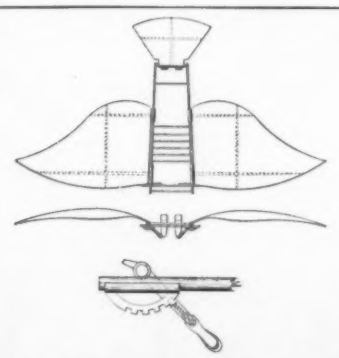


Fig. 1. Motorless glider designed and patented by W. Inhelder

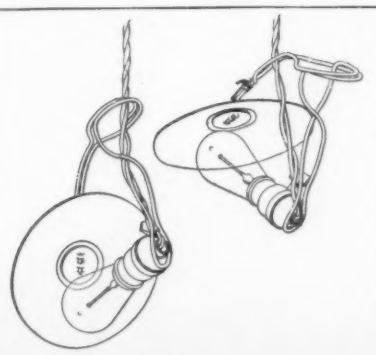


Fig. 2. Freely adjustable lamp supporter invented by R. S. Bradley

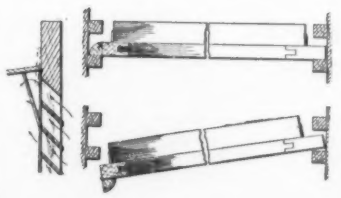


Fig. 3. B. F. Ladue's storm sash, combined with window screen

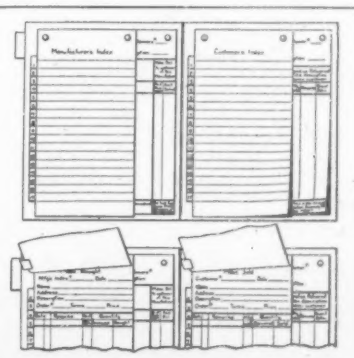


Fig. 4. Improved bookkeeping system devised by F. W. Woglom

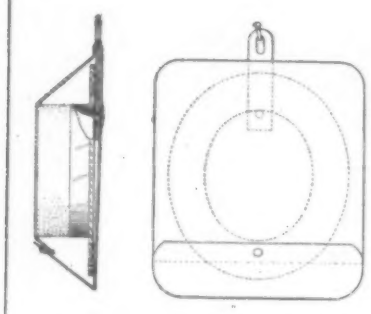


Fig. 5. Hat and garment protector patented by J. J. O'Leary

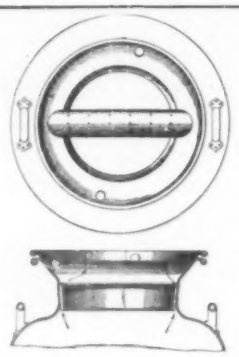


Fig. 6. G. T. Morris' ventilated cover for containers

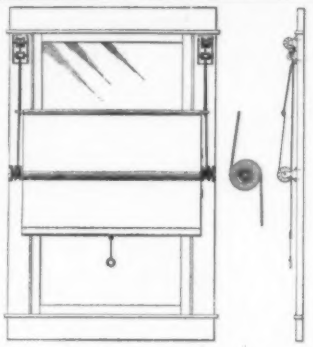


Fig. 7. Novel window-shade assembly invented by W. F. Church

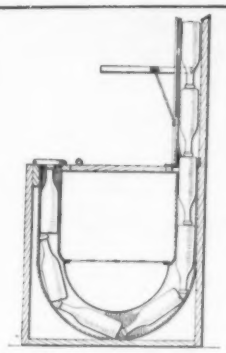


Fig. 8. Dispensing machine for cold bottled beverages, the invention of J. H. McKim

producing a wall structure which will simulate in appearance, effect, and waterproofness, the usual type of shingle wall construction, the block being of similar size and dimensions to that of the standard shingle wall construction.

DETACHABLE HANDLE FOR BROOMS.—W. H. ZACHRY, Humphres St. and Southern Ry., Atlanta, Ga. The invention has for its object to provide a broom having a detachable handle adapted to be positively and rigidly associated with the broom structure, and which is of simple and durable construction easily attached to the broom head, and comparatively inexpensive to manufacture.

TRAP.—H. M. BRITAN, Ojus, Fla. The invention relates to a spring trap especially adapted for trapping mice, rats and the like. An important object is to provide a wide treadle plate which not only acts as an apron to keep the base of the trap clean, but also acts as a contact member so that if the rat or mouse stands thereon the trap will be sprung. A further object is to provide a bait carrier especially adapted to receive loose grains.

RUG AND PROCESS FOR MAKING SAME.—R. S. MATHIS, 413 Filmore St., Corinth, Miss. An object of this invention is the provision of a process for forming a rug whereby the rug will be more ornamental, more serviceable, and more economical to manufacture, and whereby the center of the rug will have in effect a continuous flat surface whereby puckering or buckling-up will be prevented.

CANNING DEVICE.—I. RANCADORE and L. PECORARO, 687 Locust St., San Jose, Calif. The invention relates in general to the canning industry, and particularly to a device for facilitating the packing of food products such as string beans, asparagus or the like, which for the purposes of convenience are usually packed in upstanding position with the pieces arranged substantially parallel to one another; the device is used as a means of assembling the products before transferring them to the can.

GOPHER GUN.—R. F. ARMSTRONG, Box 353, La Cygne, Kans. The invention relates to a gun which is operated by the gopher when the animal is in the line of fire whereby destruction is made certain, the gun is positioned so as to be most effective in its purpose. Another object is to provide a gun which is simple, reliable in operation, and inexpensive to manufacture.

BAG.—D. TRAUM, c/o. Dritz-Traum Co., 27 E. 22nd St., New York, N. Y. The invention has for its object to provide a ladies' handbag or pocket book of a pattern wherein a beaded structure is presented which is very inexpensive, but presents a very pleasing appearance. A further object is to provide a stamped set of blanks with lines guiding a worker in applying the beads so as to present the appearance of a woven structure.

HAIR CURLER.—A. C. HEATHCOTE, 6124 Justine St., Chicago, Ill. An object of the invention is to provide a hair curler which may be used a multiplicity of times with but little wear thereto. A further object is to provide a device by means of which the hair may be curled or waved without the application of heat. The device is simple and may be easily applied.

SPRAY GUN.—L. L. TIRRELL, c/o Tirrell Mfg. Co., Bridgeman, Mich. Among the objects of this invention is to provide a spray gun for spraying ceilings or the like, in which the liquid is thoroughly atomized and subsequently projected through a suitable nozzle. A further object is to provide a device in which the atomized liquid may be projected through one or two nozzles by merely turning the central feed tube.

FOUNTAIN BRUSH.—J. V. HUETHER, 526 59th St., Brooklyn, N. Y. The invention relates to combined containers and applicators for semi-liquid or past coating substances such as shoe or stove polishes. Among the objects is to provide a brush or dauber which includes means for the accommodation of a supply of polish, and means for feeding the same as needed, and means for shutting off the feed to prevent waste; and means for replenishing the supply.

MEANS FOR OBTAINING SPHERICAL RELIEF IN PICTURES.—A. E. BERTELSON, 171 W. 23rd St., New York, N. Y. An object of the invention is to provide a device in which a picture drawn upon a flat surface having two dimensions may be viewed through a transparent plate and given the appearance of a picture having three dimensions, the third dimension representing depth, concave cylindrical lenses of various powers being employed to produce the result.

FASHIONED ANKLE AND ARCH SUPPORT.—A. POSNER, 149 Roebling St., Brooklyn, N. Y. The invention has for its object to provide an ankle and arch support more especially designed for inserting in boots or shoes of standard makes and sizes and fashioned to provide an aid to the foot particularly when the wearer is exercising, climbing, golfing, skating, or indulging in sports liable to strain the foot, the device especially supporting the ankle bone.

FOLDING STOCKING STRETCHER.—H. A. BERENDSEN, Bangor, Pa. The invention relates to a stocking stretcher which unfolded presents a proper form on which a stocking may be positioned for stretching and drying and when not in use may be folded to a compact body and easily stored. The device is simple, may be quickly folded and unfolded, and may be adjusted to accommodate stockings of different sizes.

HANDBAND OR PROTECTOR FOR BASEBALL PLAYERS.—E. KOBBE, c/o Parker Stearns & Co., 300 Sheffield Ave., Brooklyn, N. Y. The invention has for its object the provision of a simple device whereby the hands of a person playing a game, such as baseball, especially that portion of the hand over the bone joints, may be protected from the impact of such an object as a baseball. The device comprises a hollow cushioning means of rubber which may be inflated, disposed on a band over one of the joints.

WINDOW CLEANING DEVICE.—G. HUNTER, 418 Central Park West, New York, N. Y. An object of the invention is to provide a simple means whereby both of the glass surfaces of a window may be readily cleaned from the inside, without requiring the operator to stand upon narrow window ledges or attempt to reach the outside of the glass from within, both of which conditions may be difficult and dangerous.

STOPPER.—C. J. CROSS, 149 Church St., New York, N. Y. It is the purpose of this invention to construct a stopper so as to insure the removal of the stopper by means of a pull on the bottle or container and to permit a certain amount of adjustment of the stopper transversely to insure a tight fit in the neck of the bottle; the device is particularly adapted for fire extinguisher containers.

STOCK CARD.—R. H. REED, Klamath Falls, Oregon. An object of the invention is to provide a card having means for indicating the exact quantity of stock on hand, and means to indicate the movement of the stock. A further feature is that the stock card indicates the correct location of the stock so that verification may be made at any time by a person not thoroughly acquainted in the stock room.

SCALE.—M. M. MUNK, 3436 Mt. Pleasant St., N. W., Washington, D. C. One of the foremost objects of this invention is to provide a scale for weighing letters and other small objects. Another object is to provide a cheaply manufactured scale which consists of a few parts stamped out of sheet metal and bent into proper shape, and to provide an arrangement of fulcrums possessing a degree of yieldability which prevent the scales lever from jamming.

FLY SWATTER.—H. W. MANGOLD and A. M. MANGOLD, 442 So. 9th St., San Jose, Calif. An important object of the invention is to provide a fly swatter having a handle, the forward portion of which is formed with an elongated loop about which a striking element such as a piece of rubber is extended and the striking element is provided with attaching portions secured to the body both inside and exteriorly of the loop whereby a positive connection is provided between the striking element and the loop.

X-RAY FILM HOLDER.—A. HALLENBERG, Fargo, N. D. An object of the invention is to provide a device having means for holding an x-ray film in a desired position within the mouth of a patient, and for indicating to the operator the exact position of the film, whereby the rays can be so directed that the shadow cast on the film will conform in contour to the selected object which is opaque to the rays.

PLUG.—L. STEPHENS, 508 3rd St., Marietta, Ohio. Briefly stated this invention relates to a packing plug preferably formed of a single piece of wood or the like and having a plurality of segmental sections adapted to be moved longitudinally with relation to each other so as to increase the cross sectional area of the plug. A further object is to provide a plug which is of highly simplified construction.

HAIR IRON.—J. P. CANEAVRI, c/o J. E. Rose, Atty., Box 275, Port Arthur, Texas. Among the objects of the invention is to provide a device which has a wide range of utility being capable of advantageous use in either crimping or straightening the hair in any desired manner and to any degree: the device is provided with electric heating elements, is simple and durable, and safe in operation.

DYNAMITE PUNCH.—R. M. FUZZARD, 100 So. Miami Ave., Miami, Fla. The invention relates to punchers especially adapted for punching a hole in a stick of dynamite preparatory to inserting a cap in the cartridge. An important object is to provide a punch which will effectively hold a stick of dynamite in position during the operation of the punch so that the hole may be safely and expeditiously formed, either in the end or side of the stick.

TRAP.—P. STRONG, Box 308, Oatman, Ariz. The particular object of the invention is to provide a self-operating trap comprising an individual cage adapted to trap animals and to deliver them into a larger compartment, returning automatically to its set position. The trap once set up needs hardly any attention since it automatically sets itself, its capacity is limited only by size of the confining compartment.

TOOTHPICK.—R. E. LUNDAY, Keystone Hotel, San Francisco, Calif. An object of the invention is to provide a toothpick of simple construction which is adapted to be readily secured to the tongue of the user, whereby the inner side of the teeth may be cleaned. A further object is to provide a device of the character described which is made of a resilient material whereby it will readily conform to the tongue.

WALL CONSTRUCTION.—J. A. LYNCH, Leonia, N. J. The invention relates more particularly to a wall construction formed of brick of the ordinary type combined with a special form of building block. One of the primary objects is to construct the wall so that between the inner and outer surfaces there will be provided air spaces for the purpose of eliminating moisture.

KEY CHAIN REEL.—T. J. MORRISON, 367 W. 123rd St., New York, N. Y. The general object of the invention is the provision of a compact reel and casing, provided with extensible means for holding a key chain or the like, the device operating to retain the extensible key chain in its extended position for unlocking a door, and in a manner that may be operated to draw the extensible key holding means into the casing, and hold the keys close to the body.

HAT PROTECTOR.—J. J. O'LEARY, Hiets Lane, Glenside, Pa. This invention has for its object to provide a simple, economical and efficient covering for hats or garments whereby they can be very easily stored away and protected from dust and dirt, the garment being not only stored within the protector, but also firmly supported. The protector is so constructed that it may be manufactured at a very low cost. (See Fig. 5.)

VENTILATING COVER FOR CONTAINERS.—G. T. MORRIS, c/o Wm. Wayne, Missoula, Mont. The invention relates more particularly to containers employed for transporting milk, cream and the like. One of the primary objects is to provide a container in which the interior will be at all times in communication with the exterior, to afford proper ventilation of the contents. It is a further object to so construct the cover for milk containers that the gases generated within the container may be discharged therefrom. (See Fig. 6.)

WINDOW SHADE.—W. F. CHURCH, Mrs. Mary M. Church, executrix, P. O. Box 1327, Greeley, Colo. This invention relates to window shades for curtains of the type including two shades both adapted to be drawn from the same roller in opposite directions when the roller is located at a point intermediate to top and bottom of the window, so that imparting a turning movement to the roller one curtain portion is drawn up and the other is simultaneously drawn down. (See Fig. 7.)

REFRIGERATOR.—J. H. MCKIM, Box 766, Mobile, Ala. The invention relates to a dispensing refrigerator for bottled beverages or liquids, and has for its object to provide a device which is of such simple and durable construction as to present a compact and ornamental appearance and yet contain and cool a relatively large number of bottles which may be conveniently dispensed by a simple ejecting mechanism in the form of a spring finger. The bottles are exposed to the full effect of the cooling medium and yet protected against breakage or injury. (See Fig. 8.)

DISPLAY RACK.—G. F. BREUNINGER, 763 So. 19th St., Newark, N. J. An object of the invention is to provide a display rack in which the use of spring arms for holding the articles displayed is practically done away with, and a rack which may be conveniently utilized for supporting a number of newspapers or magazines in such a position that the headlines of the papers or names of the magazines are all exposed to view.

ARTISTS' FRAME.—E. J. MARTIN, 11 Pratt St., New Rochelle, N. Y. This invention is particularly designed for use by

scenic artists. The general object is the provision of an adjustable frame for supporting a flexible paint receiving foundation, of dimensions several times that of the cross section of the building or room in which it is desired to work; the device is capable of accommodating various sizes of paint receiving foundations.

PUNCTURING ATTACHMENT FOR COLLAPSIBLE TUBES.—G. S. TURNER, 218 Raritan Ave., New Brunswick, N. J. The general object of the invention is to provide a puncturing attachment to be carried by the tube and held in position by the usual screw cap until required for use, a more specific object being to provide an attachment of such character as not to detract from the appearance of the tube, and so formed and arranged that it will not constitute an obstruction in the ordinary handling of the tube. (See Fig. 9.)

Hardware and Tools

TOOL.—F. GARRISON, Wendell, Idaho. The invention relates in general to tools such as pliers, pincers or the like, the object is to provide a tool of this character which embodies foldable handle members whereby the tool, when not in use, may be folded up into a compact article capable of being carried around in the pocket without discomfort.

LOCK.—A. YUROW, c/o S. M. Elowsky, 346 Crown St., Brooklyn, N. Y. The principal object of the invention is to provide a lock in which the bolt is effectively protected against "jimmying" or tampering with either from the outside or inside of the door, both by the keeper and the casing. The invention aims to provide a lock keeper and casing construction which is applicable either to a spring lock or locks of the dead-latch type.

WINDOW FASTENER.—A. F. LAGERSTROM, 5749 S. Maplewood Ave., Chicago, Ill. The invention has for its object the provision of a device which will enable the locking of a pair of slidably mounted window sashes. A further object is to provide a device which may be secured in an unlocked position, thus obviating the accidental engagement of the lock in raising or lowering the sash.

COMBINATION TOOL.—H. SCHUETZ, Las Plumas, Calif. The invention relates to combination tools, the purpose being the provision of a tool which is adaptable to a plurality of uses, and which is of simple construction, it being placed in compact form when not in use. The device is adapted to form a carpenter's square, a carpenter's rule, a pair of calipers, a glass cutting implement, and may be adapted to hold safety razor blades during the honing or stropping.

MEAT HOOK.—A. W. WEYEL, c/o J. B. Gontrum, Atty., 429 New Amsterdam Bldg., Baltimore, Md. An object of this invention is to provide a hook, the individual members of which may be swung inwardly toward each other, so that the meat hook can be collapsed and stored when not in use. Another object is to provide a hook with radiating hook members, enabling the hanging of a plurality of carcases.

COMBINATION LOCK.—W. H. JAY, Box 67, Mobridge, S. D. The primary object of this invention is to provide a permutation lock which is practically proof against unwarranted manipulation, and which is simple, durable and pleasing in appearance, yet strong, the arrangement of the parts being such that the lock is adapted to a variety of uses.

COMBINED DEPTH AND HEIGHT GAGE.—L. J. HOGARTY, 150 So. Oxford St., Brooklyn, N. Y. The invention relates to geometrical instruments, and its object is to provide a combined depth and height gage of the micrometer type and arranged to enable the user to readily see and read the distance between opposed contacts to one ten thousandth of an inch. Another object is to permit of detaching the micrometer caliper for use as such.

VALVE GRINDER.—A. LOVELESS, 1123 East Market St., Aberdeen, Wash. Among the objects of this invention is to provide a valve grinder which is of simple and durable construction, which may be readily applied to the engine whose valves are to be ground, and which may be operated without the exercise of special skill or of laborious effort, and to insure proper seating and efficient action of the valve after the grinding operation.

AUTOMATIC SHIELD FOR CIRCULAR SAWS.—J. E. LANTZ, 1471 W. 73rd St., Chicago, Ill. The invention relates to devices for guarding saw blades to prevent injury to an operator. An object is to provide a device that can be arranged in a desired position with respect to the saw blade, and comprises relatively adjustable parts, whereby it is suitable for use with saws of various sizes, and can be applied to saw or work supporting means of ordinary construction without any extensive changes being required.

ROUTING HEAD.—A. MARCEAU, 103 Pineapple St., Brooklyn, N. Y. The object of the invention is to provide a routing head for photo-engraving work and arranged to insure free running of the tool-carrying spindle and reduce wear to a minimum thus prolonging the life of the running parts. Another object is to allow convenient and quick assembling and disassembling of the running parts.

NUT LOCK.—A. R. JOY, Moose Temple, Portland, Ore. The main object of the invention is to provide an absolutely firm and secure lock for a nut, and to prevent the possibilities of its becoming loose by reason of constant jar or exposure to the elements. A further object is to provide a washer with a locking lip which constitutes a further, or double lock for the nut.

TOOL FOR COMPRESSING VALVE SPRINGS.—S. C. HOFF, Highway Dept., San Antonio, Texas. Among the objects of the invention is to provide a tool including a fixed fork and a movable fork adapted to cooperate in compressing a spring, and to provide means whereby the movable fork is constantly in parallelism with the fixed fork at all points of travel; the devices is simple, durable, and inexpensive to manufacture.

Heating and Lighting

PORTABLE OVEN.—I. H. PAWLICK, c/o Enterprise Portable Oven Co., 1502 Clybourn Ave., Chicago, Ill. Among the objects of this invention is to provide a portable oven which may be readily disassembled and packed in a relatively small space for shipment. A further object is to provide an oven with a plurality of shelves, which is adapted to various kinds of heat and which makes use of a novel form of door construction.

AUTOMATIC DRAFT REGULATOR.—V. B. CARR and S. H. BROSHAR, 217 W. Chicago Ave., Lebanon, Ind. An object of the invention is to provide an automatic draft regulator for a furnace which is actuated by the steam pressure in the boiler. A further object is to provide adjustable means for automatically keeping the pressure of steam in the boiler at a predetermined point, and automatically regulating the opening and closing of the draft door and the check draft.

BUCKET.—W. L. THOMPSON, 324 Wernberg Bldg., Greenville, Miss. One of the principal objects of the invention is to provide an earth-working bucket which is particularly capable of use as a scraper bucket. Another object is to provide a bucket which will not only be under the complete control of the operator but will also serve to effectively accumulate the material and retain the same in the bucket while it is being conveyed to the desired points.

HEATER.—E. D. STOUT, c/o W. H. Jackson Co., 2 W. 47th St., New York, N. Y. The invention relates to heaters of the electric type. Among the objects is to provide a permanent heater especially adapted to bathrooms and similar localities, mounted within a recess in the wall and so constructed that the outer portion is in imitation of an ordinary hot-air register, the outer face being flush with the wall.

Machines and Mechanical Devices

TOBACCO PACKER.—O. R. MATSON, c/o R. N. Nelson, 117 W. Main St., Madison, Wis. The object of the invention is to provide mechanism for easily and readily compressing or packing tobacco leaves into the desired bales or bundles, the device is adapted to operate on all varieties of tobacco, is readily controlled, and in general is of simple and durable construction.

MACHINE FOR SHAPING CYLINDERS.—A. VAN A. FELTEN, 38 Morris St., Danbury, Conn. The aim of this invention is to provide a device for use in connection with the making of metallic receptacles, although not necessarily limited to this particular adaptation. An object is to provide a machine by means of which a cylinder may be treated to form a flange or corrugation in the body, means being provided to at all times retain the cylinder in proper position with the operating parts of the machine.

FUR SOFTENING AND CLEANING MACHINE.—S. FRIEDMAN, 48 Lafayette Ave., Evergreen, Brooklyn, N. Y. The invention relates to furs and pelts, its object is to provide a machine for softening and cleaning fur garments and fur skins in a quick and effective manner without danger of injury to the garment or skin. A further object is to facilitate the placing of the garment or skin into the machine and the removal of the same therefrom, and the separating of the cleaning medium from the garment or skin.

HOLLOW STEM SUCTION VALVE.—P. R. ROTHE, 915 N. Waller St., Chicago, Ill. An object of the invention is to provide a form of valve designed particularly for use in the inlet of apparatus for compressing elastic fluids, such as air, oxygen, nitrogen, ammonia or other gases to a pressure up to 3,000 pounds. A further object is to provide a device constructed to remain closed when the elastic fluid is being compressed and consequently permit no return of the gas through the inlet port.

POSITIONING MEANS FOR PISTONS.—L. R. DAVIS and R. M. HUGHES, 660 Turk St., San Francisco, Calif. The particular object of the invention is to provide means for positioning the internal studs of a piston so as to aline the same with a drill guide for the purpose of boring a hole through the studs adapted to receive the wrist pin to which the connecting rod is attached. The device will accomplish the object with little loss of time and with machine-like accuracy.

CLAMSHELL-BUCKET-OPERATING MECHANISM. — S. O. NAFZIGER, c/o American Mfg. & Eng. Co., Goshen, Ind. An object of the invention is to provide a light clamshell bucket which has means for positively holding it rigidly while the two halves are being closed in the act of digging. A further object is to provide means to steady the bucket while it is being raised or lowered, and to provide a track runway construction on which the operating mechanism is carried.

GLASS FINISHING AND POLISHING MACHINE.—G. C. SCOTT, Watson, W. Va. The invention relates generally to a machine for smoothing the edges of pressed glassware in the nature of drinking glasses or tumblers as well as polishing the external surface thereof, the object being the provision of a continuously operating machine capable of movement under manual or mechanical power and of ready adjustment.

RINSE TUB.—P. O. VANATTER, Athens, Ga. Among the objects of the invention is to provide a rinse tub having rotary mounting and divided into communicating compartments extending to the center of the tub so that the tub may be turned to present any compartment to a station desired, either for the operator, or a heater, or for a drain. (See Fig. 10.)

FLESHING MACHINE.—S. FRIEDMAN, 48 Lafayette Ave., Evergreen, Brooklyn, N. Y. This invention relates to a machine for cutting the flesh from skins, and more particularly to a machine in which the revolving knife has the general form of a disk in which high-grade steel is employed in the manufacture. More specifically the invention has in view a knife that may be ground with facility and that will enable the cutting edge to be preserved by a whetstone.

MECHANICAL RACING COURSE.—G. LANGLUME and E. J. YBARZABAL, New Orleans, La. An important object of this invention is to provide an amusement device wherein a plurality of continuous rows of mechanical horses are caused to travel in a given course to represent a horse race. A further object is to provide means whereby the horses or figures are supported for movement in such manner that tipping over of the figures is prevented.

UNIVERSAL CUTTING AND KNEADING MACHINE.—L. NEGRO, 3 Strada Smardan, Bucharest, Roumania. The invention has for its object to provide a universal cutting and kneading machine for materials of any kind, it substantially comprises two main parts, viz.: two continuous acting cutting and kneading cylinders on the one hand, and a metal support or frame containing the material on the other hand.

Pertaining to Vehicles

BOW PROTECTOR FOR AUTOMOBILE TOPS.—T. H. MURPHY, L. S. ISBELL and E. W. SAWYER, c/o Elmer W. Sawyer, Atty., North Anson, Me. Among the objects of the invention is to provide a safety device in the form of a cushion protecting means for the bow of a top of an automobile whereby to avoid possible injury, should an occupant of the rear seat be thrown upwardly and strike his head upon the bow. The device comprises a casing which may be inflated, and is adapted to be fitted upon the lower side of the bridge portion of the bow. (See Fig. 11.)

RESILIENT WHEEL.—J. SCHMIDT, 629 Ninth Ave., New York, N. Y. One of the primary objects of the invention is to provide a wheel of the resilient type in which the resiliency is produced by a plurality of springs. A further object is to provide a wheel in which a cushion tire may be employed with the result that resiliency equivalent to that obtained in a pneumatic tire is attained. The device may be readily disassembled for the purpose of repair or the like. (See Fig. 12.)

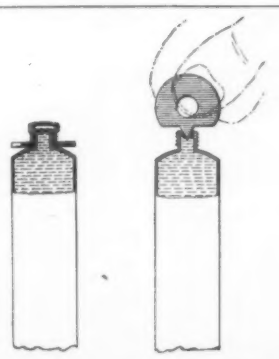


Fig. 9. G. S. Turner shows a new way to get the contents of a container tube

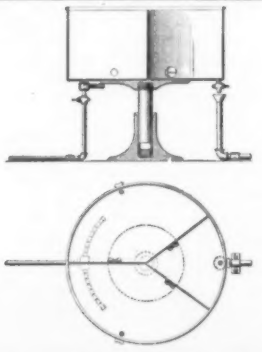


Fig. 10. Rotating, partitioned rinse-tub invented by P. O. Vanatter

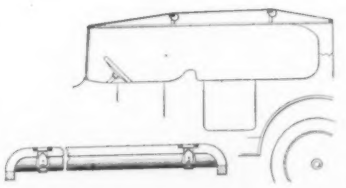


Fig. 11. Invention of E. W. Sawyer and others for protecting the automobile-top bow from injury by the riders' heads

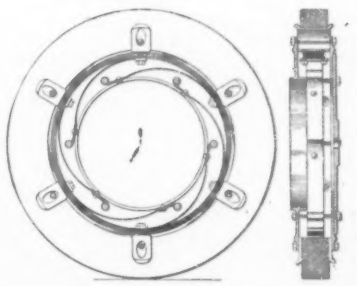


Fig. 12. Resilient wheel to permit the substitution of cushion tire for pneumatic, patented by J. Schmidt

RADIATOR HOLDER.—J. W. KAGER, c/o Levinski & Levinski, Butte, Mont. The invention relates to means for holding a radiator in the manufacture or repair of the same, and has for its object to provide means whereby the radiator may be turned in its own plane or rocked vertically, whereby to dispose the radiator in various angular positions to make all points readily accessible.

VEHICLE SPRING.—W. E. STANFORD, Taylorville, Calif. The general object of the invention is to provide a spring assemblage of leaf springs and appurtenances to afford the maximum resiliency and to constitute effective shock absorbers without the necessity of employing shock absorbers additional to the springs. The assemblage includes upper and lower curved springs.

AIR RELEASE DEVICE.—W. A. E. MADDOCK, c/o M. E. Church, Milton, N. D. Briefly stated the important object of this invention is to provide an air release device having simple means whereby the same may be readily attached to a valve stem for unseating the valve, and thereby permit air to escape from the tire. The device is of simple construction and is durable in use.

LUBRICATING DEVICE. — E. R. BALES, 1432 E. 65th St., Chicago, Ill. This invention relates to a device for lubricating the air cylinders of a two-stage air compressor and is primarily designed for use with air compressors used on locomotives. The object is to provide a lubricator that may be fed from some convenient place, and having a restricted feed opening which checks the flow of oil, preventing an over supply.

TIRE-CHAIN TIGHTENER AND LOCK.—L. SLAMA, c/o Slama Auto Co., Humboldt, Neb. Among the objects of the invention is to provide a chain tightener and lock which comprises two members pivotally secured and which are adapted to be locked in closed position by means of a spring pressed pin which takes the place of the usual cotter pin and which securely locks together the two members of the device.

SHIELD.—A. C. SANDERS, Helena, Ark. The object of the invention is to provide combined ventilating and sun-shield for automobiles, adapted to be mounted or attached to any standard type of car and to permit free passage of air therethrough, at the same time protect the driver from sun glare, also to prevent insects or other foreign elements in the atmosphere from passing through.

RADIATOR THERMOSTAT.—A. I. KAPLON, Brunswick, Md. This invention has for its object to provide a radiator thermostat including an incandescent lamp arranged to be lighted upon completion of the electric circuit when the mercury in the tube reaches a predetermined high or dangerous point, indicating excessive heating of the engine, so that the operator of the engine is warned in time.

AUTOMOBILE FENDER.—S. G. FITZ SIMONS, Charleston, S. C. An important object of the invention is to provide an automobile fender, which is rigidly and securely held, in its open or operative position subsequent to striking a person, and more specifically to provide simple means whereby the sides will be prevented from sagging when open. The device is neat in appearance and may be cheaply manufactured.

AUTOMOBILE BRAKE.—G. PARSON, 309 E. 4th St., Plainfield, N. J. The invention relates to a brake for motor driven vehicles, the brake having brake shoes movable into and out of braking contact with the transmission shaft. The device includes a shaft, a block surrounding the shaft, a pair of brake shoes pivotally mounted at one of their ends to the block and moving toward or from the shaft on the pivoted ends.

SPRING MOUNTING.—V. W. PAGE, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn. The primary object of the invention is to provide means for connecting vehicle springs, particularly of the so-called cantilever type, to the several points of attachments at the ends. A further object is to provide a novel form of center bearing and attaching means, whereby the lubrication of the spring is greatly facilitated.

BELTING.—G. E. PERRY, Lincoln, Maine. The invention relates more particularly to link belting, an object being to provide an arrangement of flexible links such as leather or the like, in combination with coupling pins which permit an easy removal or replacement of worn or injured links without the employment of tools or the necessity of proceeding to a garage or repair shop.

EYESHIELD ATTACHMENT FOR MOTOR VEHICLES. — J. W. PRIMROSE, c/o Mrs. S W. Harlison, 112 N. Hinds, Greenville, Miss. The object of this invention is to provide an adjustable eye shield for drivers of motor vehicles which may be positioned immediately forward of the driver and at the rear of the windshield associated with the vehicle, and thereby efficiently protect the driver's eyes from the sun glare or the lights of oncoming vehicles.

SPRING WHEEL.—G. W. WATTS, 526 N. Penn St., Indianapolis, Ind. The invention relates to a spring wheel especially adapted for use with trucks, although it may be used with motor vehicles generally, as well as other vehicles. The object is to provide a spring in which the springs are so organized with each other and with the other elements of the wheel that all the springs are active to support the load and to absorb shocks.

COLLAPSIBLE HOOD OR ROOF OF VEHICLES.—G. BAEHR, 2 Rue des Sablons, Paris, France. The invention relates to a device for mounting glazed frames intended for use in conjunction with motor cars and permitting of readily bringing the frames into either the inoperative or operative position without it being necessary to support manually the whole weight of the frame.

STRAINER.—J. H. CRARY, Flushing, N. Y. The invention particularly relates to a strainer of the type commonly employed for preventing the entrance of dirt into the carburetor of an automobile. The primary object is to provide a strainer, which may be cleaned without being taken apart. A further object is to provide a strainer which is durable, efficient, simple and inexpensive to manufacture.

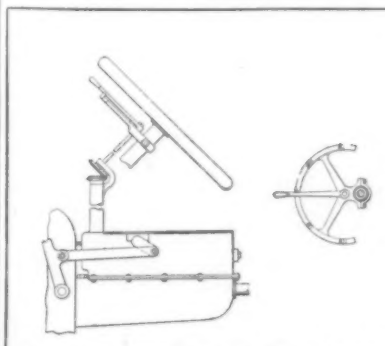


Fig. 13. Automobile transmission of the constant-mesh type, designed by W. S. Cunningham

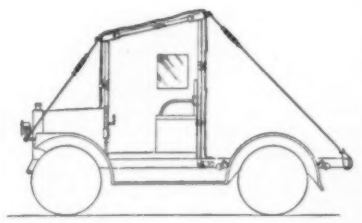


Fig. 14. Portable cab for trucks, the invention of E. D. Blackinton and G. E. Smith

AIR PUMP. — E. WITMAN, Sinking Spring, Pa. The general object of this invention is to provide a tire pump that will efficiently function as a double-acting pump to effect discharge of air with each forward and return stroke of the piston. A special object is to provide a device of strength and simplicity.

SAFETY DEVICE FOR INFLATING PNEUMATIC TIRES.—H. H. BREEDEN, Millville, N. J. The principal object of the invention is the provision of automatic means for the prevention of over inflation and bursting of a tire when under the process of inflation, a further object being to provide a device which constitutes means for gauging the air supply, whereby it may be compressed within the tire under a predetermined degree of pressure.

RESILIENT WHEEL.—M. J. DUFFY, 93 Butler St., Brooklyn, N. Y. Among the objects of the invention is to provide a wheel employing springs by means of which a conventional solid rubber tire may be used to advantage. A further object is the construction of a resilient wheel in which the parts will at all times be accessible for inspection, adjustment and oiling.

BRAKE IRON.—S. L. HALL, c/o Grant Connally, 201 E. Main St., Cushing, Okla. The invention relates to brake irons for use in connection with wagons, although not limited to this use, an object being to provide an iron which is strong and rigid, which can be readily secured to the brake beam, and which supports the brake shoe so that the latter may be adjusted when worn. The iron may be cast in a single piece.

LUBRICATING DEVICE FOR AUTOMOBILES, ETC.—R. B. HANSCOM, 133 N. 10th St., Klamath Falls, Oregon. The chief object of this invention is to provide a conduit which is adapted to be installed in the crank case of an automobile for conducting a lubricating liquid from a reservoir to the lubricant receptacles in the crank case. A further object is to provide a conduit that has no inward projecting portions which would tend to interfere with the flow of the liquid.

FLOOR PLATE.—J. E. ERSKINE, 920 Main St., Jacksonville, Fla. This invention relates to a plate adapted to be attached to the running board of an automobile. An object is to provide a relatively simple device that will enhance the appearance of the running board. A further object is to provide a plate which embodies a foot scraper, whereby dirt scraped from the foot may fall to the ground without being deposited on the running board.

CLUTCH LOCK FOR MOTOR VEHICLES.—L. A. CALAME, 718 W. Ringold St., Freeport, Ill. Among the objects of the invention is to provide a clutch lock in which means is provided for positively locking the transmission clutch in a position to disconnect the motor from the transmission mechanism, and to provide a device which may be easily attached to the standard types of motor vehicles, the device being concealed from view, with the exception of the foot plunger and adjacent spring lock.

RESILIENT WHEEL.—C. E. WIGGINS, Delhi, La. The object of this invention is to provide a resilient wheel which is well adapted for use on automobiles or other vehicles and wherein a high degree of resiliency is obtained so as to give the vehicle easy riding properties for use as a passenger vehicle and relieving the running gear and other parts of strains and shocks and rendering the employment of a pneumatic tire unnecessary.

INTERNAL BRAKE.—V. W. PAGE, c/o Victor W. Page, Melrose Ave., Stamford, Conn. This invention relates to vertical brakes of the internal type, expanded by means of a cam. The primary object is to provide adjustable surfaces for the cam to engage in order that the throw of the shoes may be restored to normal when the wearing surfaces have become worn. A further object is to provide means for securing the brake lining or friction surface to the shoes.

TOP FOR VEHICLE BODIES.—C. P. POND, c/o George L. Traffarn, Camden, N. Y. The general object of the invention is to provide a top adapted to be mounted on a vehicle body to comprise a roof, together with panels hinged to fold for sustaining the roof in a raised position for making the vehicle body more available for living purposes, and to cause the roof to be lowered onto the vehicle for traveling or entering a garage.

AUTOMOBILE MIRROR BRACKET AND JOINT.—S. FEINBERG, 363 Canal St., New York, N. Y. The invention relates to a bracket and universal joint, and has for its object the provision of means whereby a mirror in its various adjustable positions is more advantageously disposed at all times with respect to a bracket whereby the mirror can be more easily manipulated; the number of parts being small the cost of manufacture is considerably reduced.

SHOCK ABSORBER.—D. B. D. BLAKE, 400 Jersey St., Quincy, Ill. An object of the invention is to provide means whereby quick and simple adjustment of the parts of the device may be achieved, and means whereby the tension of the spring used can be quickly adjusted independently of other adjustments.

WHEEL AND TIRE CONSTRUCTION. E. H. ACKERMAN, 70 No. Willow St., Montclair, N. J. The invention provides as a feature a plurality of expansible tube sections each of which carries its own individual inflating valve and which is adapted to be arranged with a plurality of its fellows to completely fill the shoe and to be nested therein in direct end to end contact; one of the important features being the entire elimination of any transverse partitions for separating the different containers.

GREASE RETAINER.—S. R. MORDEN, 3174 Washington St., San Francisco, Calif. The invention is particularly designed for use on the rear axle of a Ford automobile although not confined to that type of machine. The principal object is to prevent grease introduced into the different housings from working outwardly along the rear axle into the brake drum. The device is easily installed, and returns the grease without in any way injuring the axle or axle housing.

COMBINED PARKING BUMPER AND THEFT INDICATOR.—L. W. NOBLES, 551 W. 169th St., New York, N. Y. An object of the invention is to provide an auxiliary bumper to be employed in connection with the main bumper, and projecting from the front and rear of the car, for preventing drivers from parking their cars too close; the bumper also serves as a theft indicator when the car is driven with the bumper locked in projected relation from the opposite ends of the car.

SHOCK ABSORBER.—R. RAGSDALE, 130 South Main St., Porterville, Calif. The invention is adapted to be used principally in connection with so-called cantilever springs. It is an object to interpose a shock absorbing means between the axle and the body of the vehicle which will cause any shock transmitted to the spring from either of the axles to actuate the spring from opposite directions and to thus spend its force in a number of minor vibrations without substantially affecting the body itself.

AUTOMOBILE TIRE-CASING TRIMMING AND LINING MACHINE.—F. C. MOORE, 302 Broad Ave., Canton, Ohio. The foremost object of the invention is to provide a machine by means of which certain fin-like rubber portions left on the tire casing in curing, can be removed and a special preparation applied to the inside of the casing, in one operation. A further object is to provide for trimming and lining an automobile tire casing, certain actions, as for example, stopping the rotation of the tire casing and the spraying of the lining fluid, being accomplished semi-automatically.

FLAT-TIRE ALARM.—M. J. BARRY, 167 Washington St., Newark, N. J. Among the objects of the invention is to produce a simple and inexpensive flat-tire alarm which is readily applicable to the wheel and tire without necessitating material alteration thereto and which operates to effectively signal the driver of the vehicle when the tire becomes flat or deflated to such an extent that further running will prove injurious to the tire.

TRANSMISSION. — W. S. CUNNINGHAM, 2027 Elizabeth St., Shreveport, La. The invention contemplates a variable speed transmission which includes constantly meshing speed gears together with means for selectively rendering the same operative whereby to eliminate the necessity of shifting the gears into engagement and the resultant disadvantages incident thereto. A further object is to provide a variable transmission, including speed selecting means, mounted on the steering column within convenient reach of the operator. (See Fig. 13.)

PORTABLE CAB.—E. D. BLACKINTON, and G. E. SMITH, address E. D. Blackinton, Groton, Conn. The general object of this invention is to provide a portable cab attachment to be conveniently used on trucks, tractors or motor vehicles, and is particularly adapted for use on a chassis; when not in use the device may be conveniently knocked down in small compass for storage or transportation. (See Fig. 14.)

Designs

DESIGN FOR A TOY ANIMAL.—ELIZABETH A. TICHLER, 14 18th Ave., Paterson, N. J.

DESIGN FOR A DOLL.—G. R. ZIMMERMAN, 42 Clifton Place, Brooklyn, N. Y.

DESIGN FOR A LIGHTING-FIXTURE ARM.—A. MILLER, c/o Radiant Lighting Fixture Co., 33 Bleecker St., New York, N. Y. This inventor has been granted two patents for ornamental lighting fixtures.

DESIGN FOR A DOLL.—C. E. GIBSON, c/o Moore & Gibson, 48 E. 21st St., New York, N. Y.

Electrical Devices

SWITCH FOR ELECTRIC IRONS.—H. BENVIE, 999 Broad St., Meriden, Conn. An object of this invention resides in the provision of a simple, efficient, and durable electric-iron switch which will operate to open the electric circuit of the line whenever the operator has to leave the iron. A further object resides in the provision of means whereby under certain conditions, if the switch cannot be worked, a fusible element will blow to cause the operation of the switch. (See Fig. 15.)

Hardware and Tools

SCISSORS SHARPENER.—EMILY JONES, 8 E. 72nd St., New York, N. Y. The general object of the invention is to provide a simple and durable scissors sharpener, cast from glass, which presents a neat and attractive appearance, and is of such a size that it may be carried in work boxes or the like. A further object is the provision of a sharpener adapted for use with all sizes of scissors, and that may be operated by people having little mechanical skill. (See Fig. 16.)

TURNING TOOL.—W. F. RONEY, 2210 Lowell Blvd., Denver, Colo. The object of the invention is to provide a turning tool which is adjustable so as to be readily adapted for use with work on bearings of various sizes and which is so constructed and organized as to accurately turn or "true" the bearing to its circular cross section irrespective of the adjustment of the turning tool. The tool may be readily applied to or removed from the work.

FAUCET.—G. PFLEGER, 3003 Zephyr Ave., Corliss Pa. The object of the invention is to provide a faucet which is adapted to eliminate any possible waste of water or other liquid due to the leak or tight closing. A further object is to provide a faucet having a spring pressed valve adapted to be normally closed and to associate with the valve a suitable lever for lifting the same, and means whereby the valve may be locked in raised position.

LIFTING JACK.—W. J. MELCHIOR, 309 Equity Bldg., Fargo, N. D. This invention has for its object to provide a jack which is portable and particularly adapted for raising vehicles or the like in a quick and positive manner. It is also an important object that the lifting distance of the jack be considerably greater than that possible with the usual portable jack now commonly employed.

Heating and Lighting

HEATING SYSTEM.—W. A. COLLVER, 240 Hall Ave., Marshfield, Oregon. This invention relates to a heater associated with an open fireplace and includes a hot-air heater, trash burner, distinctive smokestack elements, stack cleaning means, means to raise and lower the door to or from the fireplace, a water-circulating heating circuit, a water heating door, a range boiler, and means establishing communication between the heater door and boiler. (See Fig. 17.)

PORTABLE STOVE.—C. O. SHELDON, c/o Donna Irrigation District, Donna, Texas. The general object of the invention is to provide an oil stove adapted for outdoor use for supplying heat in orchards to prevent fruit from being damaged by frost, or for similar purposes. The device is durable in construction, economical in operation and inexpensive to manufacture.

BURNER.—F. M. DAILEN, 3746 W. Pine Blvd., St. Louis, Mo. The invention more particularly relates to that type of burner which utilizes a fluid as a fuel. An object is to provide a device which has means for providing a steady feed of fuel to the combustion chamber, and which is adapted to change a liquid fuel into a combustible gas before the latter is burned. A further object is to provide a device in which the fuel is first vaporized and then mixed with the desired quantity of air before being conveyed to the combustion chamber.

GAS HEATER.—A. T. BROCH, P.O. Box 425, City Hall Station, New York, N. Y. An object of this invention is to provide a simple one-piece fixture including a burner chamber and a mixing chamber with a connecting conduit suitably dimensioned to provide for a generous supply and flow of gas. A further object is to provide a mixing chamber so constructed that there will be no leakage of gas even at low pressure and a burning chamber in which the heat will be effectively radiated.

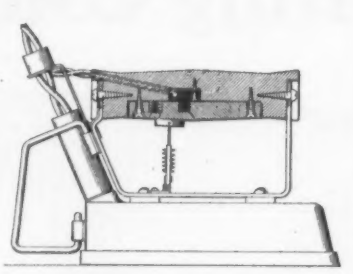


Fig. 15. H. Benvie's electric-iron switch, designed to open the circuit whenever the iron is left unattended

Fig. 16. Cast-glass scissors sharpener invented by Emily Jones

Pertaining to Vehicles

TRACTOR TRAILER.—W. C. NABORS, Mansfield, La. The primary object of the invention is to provide an arrangement whereby in a train of any desired number of trailers, used in connection with an automobile, truck, or any type of led vehicle, each of the several trailers will track in the exact path of the preceding trailers, by virtue of the special connections between the wheel turning levers, and the wheel shifting tie rods, as well as the particular connections between the body springs and the axles. (See Fig 18.)

BLOW-OUT BOOT FOR PNEUMATIC TIRES.—L. D. SHILLING, 544 4th Ave., East, Kalispell, Mont. Among the objects is to provide a "blow-out boot" which is adapted to be quickly and easily applied to the inner tube of a pneumatic tire, which is adapted to remain in position after the tire is inflated, and may be removed from the inner tube without danger either to the tube or the casing. The construction of the boot is of such a nature that it may be used repeatedly. (See Fig. 19.)

ENGINE-CONTROLLED CLUTCH-RELEASING MEANS.—R. I. BELCIA, Hull, Texas. The invention relates to the gear control of automobiles and motor cars, the object being the provision of means by which to dispense with the manual depression of clutch pedals so as to avoid the nervous strain attendant upon gear shifting, or stopping the car. In carrying out the invention the suction of the engine is used for the purpose of holding the clutch in released position when the engine is in movement, as long only as the accelerator pedal is in retracted position. (See Fig. 20.)

VALVE.—W. F. DURYEA, Hackensack, N. J. The invention has for its object to provide a valve in which means is provided for holding the valve stem against turning, so that the valve will always seat in the same place; to provide means for adjusting the valve, and to provide a novel form of locking, means for retaining the valve in slightly closed position.

CHOCK BLOCK.—G. H. LANE, 392 Perry St., Pontiac, Mich. An object of the invention is to provide a device of the character mentioned, which is constructed of one piece of stock, thus eliminating the necessity of separate tie pieces, such as must be used where two separate blocks are employed. A further object is to provide a device which cannot tip up when the load is placed thereon.

MUFFLER.—F. J. HERDLE, 1847 W. Huron St., Chicago, Ill. The invention relates to exhaust muffler for motor cars. An object is to provide a muffler in which there are means for reducing the back pressure upon products of combustion or exhaust gases. A further object is to provide a device having means for reducing noises occasioned by the rush of exhaust gases therethrough.

NON-PNEUMATIC TIRE.—C. A. FISK, 656 So. Boulevard, Bronx, N. Y. The invention has particular reference to a filler for a tire shoe or casing, its object is to provide a form of connection between the outer band of the filler element and the rim of the wheel which more efficiently functions to allow for the local compressions of the tire when encountering an obstacle or supporting the weight of the vehicle.

SIGNAL FOR VEHICLES.—W. J. COMBS, c/o W. J. McKone, Gladstone Hotel, 62nd St. and Kenwood, Chicago, Ill. Among the objects of the invention is to provide a signal for automobiles which is very simple in construction, and which has means for telling the driver of an approaching vehicle the direction in which the vehicle to which the device is attached is going. The device may be readily secured to the fender of a car. It consists of a minimum number of parts and will not easily get out of order.

END GATE.—T. L. LILLY, Lacon, Ill. The invention relates to end gates and fastening means therefor associated with a wagon body or auto truck. The invention embodies a combination flat and swinging eye-bolt, thus obviating the necessity of employing wagon rods or chains connecting the opposed sides of the wagon box, which cannot be drawn out in close quarters, while the eye-bolts as provided by the patent may be opened in a minimum of space.

SEAT.—R. M. MONTGOMERY, 1211 W. Kearsley, Flint, Mich. The object of the invention is to provide a seat for vehicles in which all shocks may be absorbed, and thus at all times insure the comfort of the occupant. The back of the seat is spring supported and adapted for free vertical movement. The seat is also supported by springs to further absorb the shocks to which it may be subjected. Roller means are also carried to hold the structure against forward tilting movement.

WHEEL FOR AUTOMOBILES.—S. KAPLAN, Monroe, La. This inventor has been granted two patents of a similar nature. Their objects are to provide a wheel of the type including a demountable rim, which is susceptible of ready and economical manufacture, the parts being in the main formed by stamping, pressing or similar mechanical processes. Another object is to provide a wheel wherein the demountable rim is easily assembled and disassembled while being securely though releasably locked, the organization being such that a single manipulation serves both to release the locking means and to release the rim from its engagement with the wheel.

OUTSIDE BRAKE.—F. J. ANDEL, 3720 E. 52nd St., Cleveland, Ohio. An object of the invention is to provide a brake operating mechanism which may be readily attached to a car of a certain type without altering the construction in the slightest. A further object is to provide a construction of outside brake which insures a quick response to the action of the brake pedal, and which brings the car to a stop smoothly and without vibration or rattle.

SPRING WHEEL.—F. PALOMBO, Stop 7, Bedford, Ohio. Among the objects of this invention is to provide a spring wheel having a series of bow springs interposed between the inner and outer members of the wheel, said springs having fixed relation to one member and at their ends having movable or rolling engagement with the other member whereby the springs can take varying positions in accordance with the strains or stresses put thereon.

TIRE CHAIN HOOK.—A. FALSTRAULT, 141 Warner Ave., Jersey City, N. J. The invention relates to anti-skid tire chains and has particular reference to a hook which connects the cross chains to the side chains. An object is to provide an attachment for the usual form of hook of this character, which converts the hook into a snaphook, and which is readily applicable to or removable from the end link of the cross chain.

SNOW REMOVING APPARATUS.—P. DUNWALD, Rio, N. Y. It is the object of this invention to provide an apparatus which may be used with an ordinary motor truck, and to provide means for attaching the apparatus to the truck. A further object is to provide a snow removing apparatus, wherein an intense heat is applied to the snow while it is in a flaky condition so that it is picked up and melted at the same time.

TIRE.—D. S. KENNEDY, 457 E. 167th St., Bronx, N. Y. The general object of the invention is to produce a solid tire having increased resiliency while preserving strength and durability; and to carry out the invention in a manner to provide a non-skid member on the tread, the tread having undercut recesses alternately at the opposite sides so that the tire radially inward of the tread presents a sinuous form.

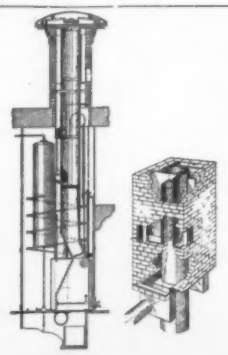


Fig. 17. Open-fireplace heating system developed by W. A. Collver

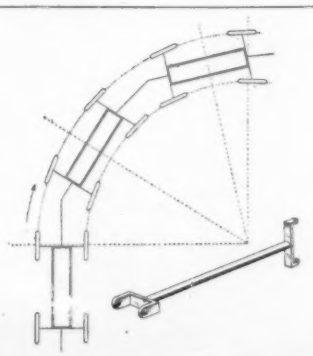


Fig. 18. W. C. Nabors' trailer connection that enables numerous trailers to track perfectly

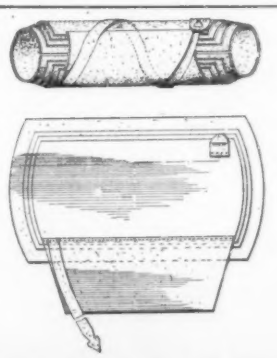


Fig. 19. Ease of application is the paramount feature of L. D. Shilling's blow-out boot

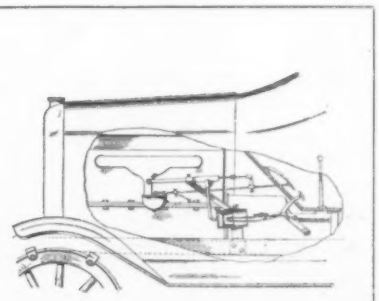


Fig. 20. Device by means of which R. I. Belcia substitutes engine-power for foot-power in operation of the automobile clutch

The Timken Roller Bearing Company~Like

The Industry's Scrap Book

NEW STYLE IN GASOLENE MOTOR CARRIAGES

GASOLENE MOTOR PARK TRAP

THE DAVISES STILL REPAIRING

Toledo, Sept. 30.—The trans-continental automobile trip of Mr. and Mrs. John Davis has not proven a great success up to date. For nearly a month the Davises have been trying to get out of Toledo, but without success. Repair work on their machine kept them here for three weeks. A week ago Sunday they broke away from the city, but their tour was short-lived for in Michigan, less than a score of miles from here, they broke down again and are stalled. The automobilists were to represent a newspaper syndicate.

A MATTER OF VANITY

"I do not think the automobile is going to be popular for any length of time with our fashionable people," said Adjutant General Corbin today. "During my recent stay in Newport I met a number of wealthy people who had purchased automobiles early in the season, and I asked them how they liked these novel vehicles. Almost without exception they told me that they did not think the fad for them would last long. They said the automobile would never take the place of the horse with the fashionable set. The fact of the matter is, the swell woman does not appear to as great advantage in an automobile as she does behind a pair of fine horses."—Brooklyn Eagle.

INN FOR TOURISTS—A WOMAN'S DREAM

"The automobile has opened a new field for women who have their own living to earn," observed a woman the other day who proposes to become the proprietor and manager of a new old-fashioned country inn. "People are just beginning to appreciate the many advantages of this novel means of travel," she observed, "and by next season I believe it will not only have taken the place of horses, but for short pleasure trips must rival the palace and observation cars.

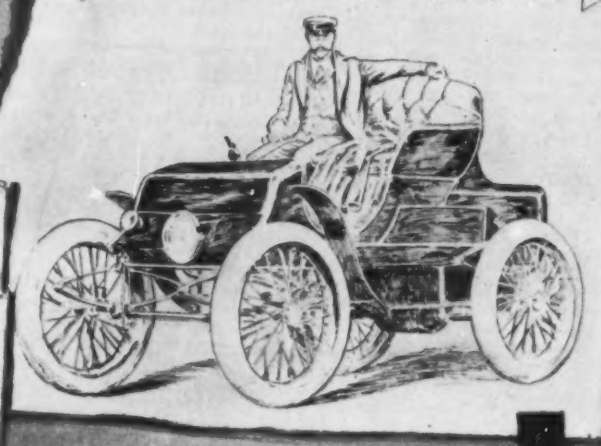
"Don't imagine I refer to our bec... ing motormen as a profession. I ... that automobiles will so increas... travel over country roads that ... bound to be a demand for well... lic houses. Inns after tho... those famous in th... coach and wh...

...ioned looking, remodeled af... of the Blue Dragon ... other famous hos... stopped in Gre... house, and ... Virginia ... are be... the ...

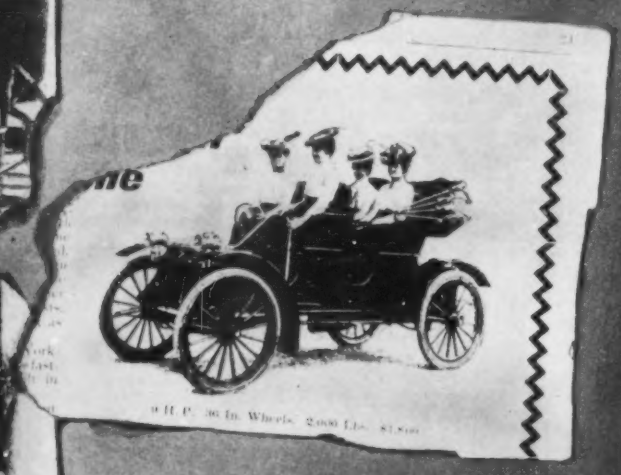
THE DAVISES STILL TRAVELING

Mr. and Mrs. John D. Davis have reached Chicago with their ill-fated motor carriage. Little of the original motor and running gear mechanism with which the couple started from New York under the auspices of the New York Herald was left, the principal remainder, it is said, being the rear axle; and that broke at the crossing of 71st street and Bond avenue in Chicago. When a new axle shall have been fitted it is the intention to proceed on the way to San Francisco.

FIRST AMERICAN RACING VEHICLE



THE INCLINE AT THE INDIANAPOLIS SHOW.



Historical Material by Courtesy Motor Age

The Automotive Industry~Is 25 Years Old

The Timken Scrap Book

AUTO INDUSTRY IS 25 YEARS OLD

Registered Owners During Quarter Century Have Reached Ten Million

NEW YORK, April 21.—The automobile industry as an industry has just celebrated its twenty-fifth anniversary. A quarter of a century ago the industry, which has produced over 10,000,000 registered owners during that period, remodeled the planning of cities and introduced the traffic "cop" struggled into being with the delivery of the first American-built car to a purchaser.

From the initial start the record of owner[illegible] until

Friction Saver vs Whip

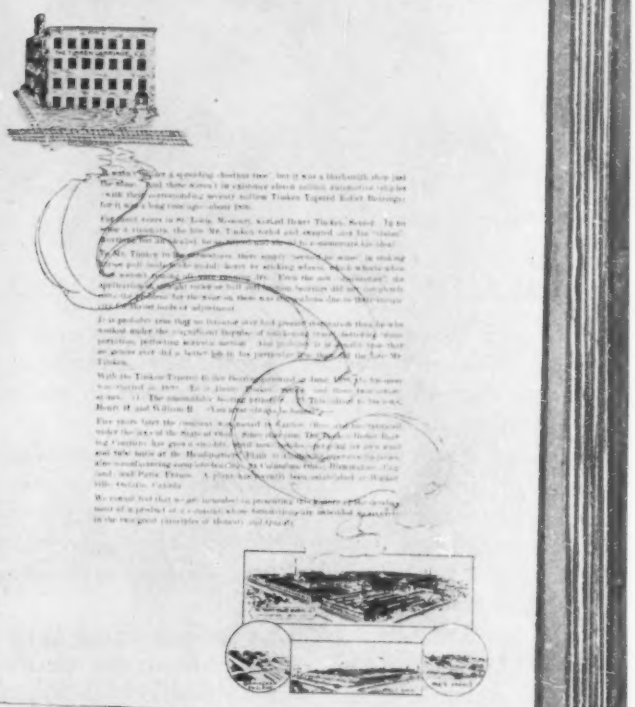
Your horse is all right. You wouldn't have to resort to old-time methods of urging him; he'd live longer and serve you better, if you'd replace the whip with the

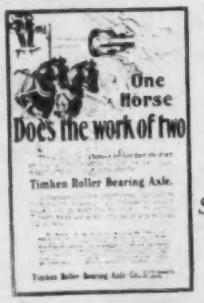
Timken Roller Bearing Axle.

Careful, scientific experiments show *50 per cent reduction in draft* on your animal, whether driven to carriage, wagon or dray. Timken Axles are easily applied to any vehicle, old or new.

The booklet, "Saving the Horse," tells how the Timken Axle reduces the draft on the horse 50 per cent; shows how the wheel turns twenty minutes on the Timken Axle before losing its momentum—how 3 pounds starts a ton on a wagon equipped with the Timken Axle, while it requires 48 pounds to start same load on a wagon with the ordinary axle. Gives interesting and valuable information for the owner or driver of spring carriage or heavy wagon. Whether you buy the Timken Axle or not, send for the booklet—it is FREE.

Timken Roller Bearing Axle Co., [illegible]





An Early TIMKEN Advertisement 1901

Since then—80,000,000 Timken Tapered Roller Bearings—the *best* Timken Bearing advertisement

The Timken Roller Bearing Co.
CANTON, OHIO

TIMKEN *Tapered* ROLLER BEARINGS

Henry Timken, Sr. in one of the early Timken-equipped horseless carriages

The Pioneers

The human animal quickly takes things foregranted. The nurseryman soon loses his ability to smell the rose; and, happily, the truck gardener soon does not smell the cabbage.

And we, "buddying" with it, speak of the Automotive Industry hundreds of times a day—superficially, thoughtlessly, with the coldness of habit.

There's more to it than just Business. Brilliant, ingenious men don't link themselves for life to penny-chasing business.

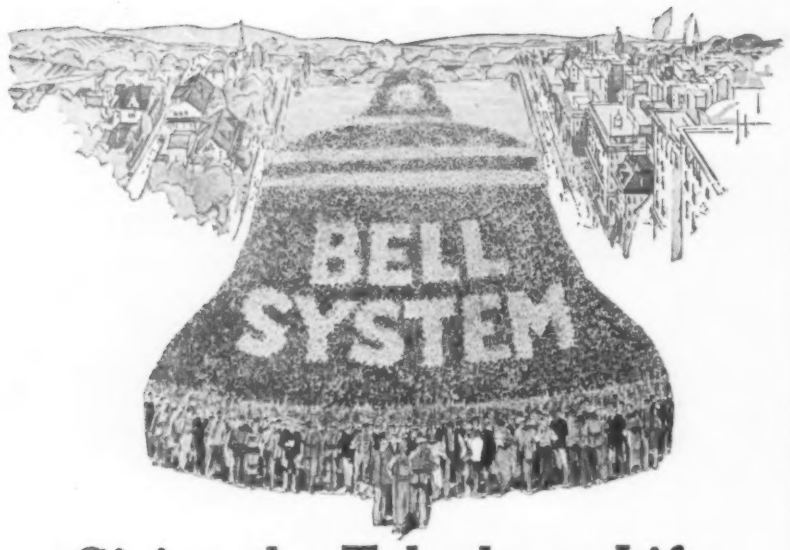
Business, yes! But Romance, and Faith, and Fiery Spirit of Adventure. Business, yes! But the business of "going somewhere"—"moving"—"on the jump" — "majestic transportation" —"miraculous motion".

We hereby appoint those old fogies—"nuts" they called them then—who with vision and (it's the only word) guts looked ahead into, say 1923, and worked; we appoint those sweating pioneers, Haynes, Apperson, Olds, Duryea, Timken, Winton, et al, as the real "See America First" Campaigners.

And rather far-sighted in their seeing, too!

Editorial from The Daily S A E,
White Sulphur Springs, W. Va., June, 1922, by
The Timken Roller Bearing Company, Canton, Ohio

© 1923 By The T R B Co. Canton, O



Giving the Telephone Life

Wherever your thought goes your voice may go. You can talk across the continent as if face to face. Your telephone is the latch to open for you any door in the land.

There is the web of wires. The many switchboards. The maze of apparatus. The millions of telephones. All are parts of a country-wide mechanism for far-speaking. The equipment has cost over 2 billion dollars, but more than equipment is needed.

There must be the guardians of the wires to keep them vital with speech-carrying electrical currents. There must be those who watch the myriads of tiny switchboard lights and answer your commands. There must be technicians of every sort to construct, repair and operate.

A quarter of a million men and women are united to give nation-wide telephone service. With their brains and hands they make the Bell System live.

"BELL SYSTEM"

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

AND ASSOCIATED COMPANIES

One Policy, One System, Universal Service and all directed toward Better Service

FORDS run 34 Miles *(on Gallon of Gasoline)*

Low Gear Seldom Used

With Air-Friction Carburetor

And we guarantee all other cars nearly double present mileage, power and flexibility, make hills on high formerly difficult on low. Models for any car, truck, tractor, marine or stationary engine. See wonderful mileage guarantees—on gallon of gasoline for other cars. Makes old cars better than new.

Ford.....34 mi.	Reo.....24 mi.	Chevrolet..32 mi.	
Buick 4.....30 mi.	Chalmers..23 mi.	Maxw'l (25) 30 mi.	
Buick 6....24 mi.	Olds. 6....23 mi.	Nash 6....23 mi.	
Hudson....20 mi.	Paige 6....20 mi.	Lincoln 8..17 mi.	
Hupp.....25 mi.	Oakland 6..24 mi.	Stdbkr Lt 6. 23 mi.	
Dodge.....20 mi.	Overl'd 4..32 mi.	Cole 8.....17 mi.	

If your car is not mentioned here send name and model for particulars and our guarantee on it. *AGENTS WANTED.*

SENT ON 30 DAY'S FREE TRIAL

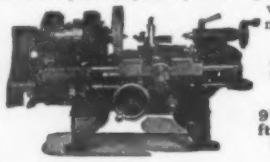
You can drive any car in heaviest traffic without shifting gears. Starts off on high in any weather without priming or heating—no jerking or choking. No more foul spark plugs or carbon in cylinders. No leaking of gas into crank case. Try it 30 days on our guarantee of money back if not entirely satisfied. No strings to our guarantee. YOU ARE THE JUDGE. Anyone who can handle a wrench can attach it. No boring of new holes or changing of operating mechanism. Write today.

AIR-FRICTION CARBURETOR CO.

272 Raymond Bldg. Dayton, Ohio, U. S. A.

A Most Efficient Tool for Home Workshop

The MONARCH Jr. Lathe is the ideal machine tool for the home workshop, repair shop and garage. Turns out, with 1000th-inch accuracy, small wood and metal parts. *Experimenters, inventors, mechanics* are enthusiastic over it. Completely equipped; auto-safety devices; semi-quick change gear. Priced within your means.



$245

9" lathe—2½ ft. bed—with bench legs

Also built with bed lengths up to 5 feet. Made in 11-inch swing size too, at slightly higher price.

THE MONARCH MACHINE TOOL CO.

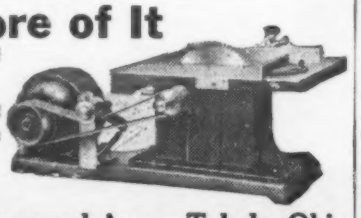
430 Oak Street SIDNEY, Ohio

Better Work and More of It

These are the results obtained to an amazing degree by hundreds of users of

Boice Junior Bench Saw

A wonderfully practical, compact, all metal machine designed for accurate and speedy sawing, ripping, grooving, etc. Cuts 1½" stock. Dadoes ½" deep and ½" wide. Driven by ¼ or ⅓ h.p. motor. Special saws cut type-metal, bakelite, brass, etc. Portable. Attaches to lamp socket.



Write for descriptive literature on the Junior Bench Saw, 4" Jointer, 14" Bench Band Saw, Bench Lathe, Bench Drills, Motors and Larger Bench Saws.

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The Scientific American Digest

A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

Exact references to the sources from which these abstracts and quotations are made follow each abstract, the numerals referring respectively to the volume, number, and pages occupied by the original article in order that those who wish for further data may refer to the originals. Other digests ordinarily appear in Electrical Notes, Service of the Chemist, and other departments which are omitted from this issue

Automotive

The Berlin Automobile Show was limited to German manufacturers of whom eighty exhibited cars. More cars were shown than at any previous show and a great many new designs were on view. In Germany, the use of front-wheel brakes is gaining steadily and at present about one-sixth of all cars are either regularly equipped with them or can be furnished with them at the buyers' option. Two good examples of front-wheel brakes are the Audi and Dux. Both types are completely inclosed, have inclined steering pivots, facilitating the steering, and are operated by cable and rods. A special brake equalizer is provided, so that the left front and right rear wheel are always applied equally, as well as the right front and left rear. The standard braking system still consists of a pedal-operated transmission brake and a lever-operated rear-wheel brake. One-fourth of all cars have both brakes acting on the rear wheels. Wire cable is used on about one-sixth of the models.—*Automotive Ind.*, 49 :16, pp. 773-78.

Civil Engineering

A Hydro-Electric Power Plant of 12,000 horsepower, operating under a head of practically one mile (1,650 meters), and having a single penstock of less than two feet diameter, was recently constructed and successfully put in operation in Switzerland. The water utilized in this development is drawn from the little lake of Fully which is located in the westerly part of the Swiss Alps at an altitude of about 7,000 feet above sea level. The lake is tapped by a tunnel and pipe line about 100 feet below normal water level. The penstock extends from the intake at the lake bottom for a distance of approximately three miles down to the valley of the Rhone River. The useful storage above the intake tunnel is 2,600 acre-feet. Due to the high head this represents a stored energy of 10,000,000 kilowatt hours. The penstock has a total length of about 15,200 feet and it is made up of a series of steel pipes of different diameters and thicknesses according to the head of water. The power plant is equipped with four units of 3000 horsepower each, arranged lengthwise with ample clearance to provide a maximum degree of safety in case that, for instance, a bucket should fly off. The waterwheels are of the Pelton type, and their construction and the design of nozzles and valves was unusually difficult, owing to the large head under which they operate. Each 3000 horsepower unit is driven by a stream of water of seven sec.-feet issuing from a nozzle of 1⅜ inches in diameter at the enormous velocity of about 540 feet per second.—*English News-Record*, 91 :10, pp. 395-96.

The Resistance of Concrete to Wear has been studied at the Structural Research Laboratory of the Lewis Institute, Chicago. It was found that the grading of the aggregate indicated that up to a certain limit the coarser the aggregate the lower the wear. These tests are difficult to summarize, but we may give two instances of 1:4 mixtures of cement and aggregate. With sand and crushed granite the least wear was shown with 20 per cent aggregate up to ⅜ inch size, 20 per cent between ⅜ inch and ¾ inch and 60 per cent ¾ inch to 1½ inch size. With crushed limestone the best proportions would appear to demand the rather larger use of the coarse at the expense of the intermediate grade. The grading may, however, vary over a wide range without affecting the results appreciably, while the wear of concrete does not depend so much upon the character of the coarser aggregate as is commonly supposed. The proper grading has much more influence according to these tests than the class of aggregate. The best results from the point of view of wear were obtained with granite, although sometimes considered not an altogether satisfactory class of material and not showing up in the strength test above the average. Blast furnace slag and limestone with the most suitable gradings gave results as good as those for granite, but the falling off with other proportions was greater than for granite.—*Engineering*, 116 :3006, p. 182.

The English Channel Tunnel Project is kept alive by its promoters, although the British government persists in refusing to grant the necessary authority, largely for national and strategic reasons. The material to be encountered for the entire distance is very favorable, being a deep bed of chalk marl, or chalk infiltrated with clay. That this material does not swell on exposure and is impervious is shown by the trial heading built in 1880-1881 and extending about a mile under the sea. With the boring machine designed for this work, and used experimentally, a heading twelve feet in diameter can be driven at the rate of 120 feet per day, and two machines started at opposite ends should meet in less than three years. It is proposed to complete this pilot tunnel or heading and then its enlargement to full section could be started at various points, so that the time for the completion of the concrete-lined tunnel is estimated at 4½ years. Instead of the usual mucking operations, the excavated material would be mixed with water to form a grout and then pumped to the surface. With present prices the cost is estimated at $145,000,000.—*English News-Record*, 91 :16, 645.

Alumina Cement was invented in 1908, but its adoption has been comparatively recent in France, where it was invented. It is very high in alumina, resistant to sea water and to sulfate waters, and hardens with extreme rapidity, so that in a day or two its concrete shows the same results as a normal portland cement concrete after a month or more. The new alumina cements are made by fusing a mixture of bauxite (aluminum ore) and limestone in a furnace, and grinding the product to powder. The carefully weighed opinions of a number of eminent engineers in France, Great Britain and the United States give results ranging between 10 per cent and 20 per cent of the portland output as representing the amount of alumina cement that we can reasonably hope to make and sell within the next ten years. Alumina cement will always be, in most parts of the United States, dearer than portland cement, and in many regions it will be very much dearer. That means that it will be to some degree a specialty product, used for such purposes or under such conditions as will justify its extra cost per barrel. Along sea coasts and in the alkali region of western Canada and our own western states, alumina cements will be used, provided that they are not too dear, because they are resistant to chemical attack. Elsewhere, on repair or construction work where time is an object, alumina cements will be used so far as their higher cost per barrel is counterbalanced by saving on time, labor and forms. *English News-Record*, 91 :9, pp. 347-49.

General

Pollution of Coastal Waters by Petroleum Oils can eventually be eliminated through the cooperation of the parties concerned, according to preliminary findings of a committee of representatives of the Bureau of Mines, the American Petroleum Institute, and the American Steamship Owner's Association. Remedial measures studied by the committee include oil-water separating devices on oil-burning ships and tankers, the providing of facilities in harbors for the collection and proper disposal of oily wastes and the use of apparatus from land plants. The committee found pollution by oil to be present in some degree at most of the 35

(Continued on page 54)

Radiotron

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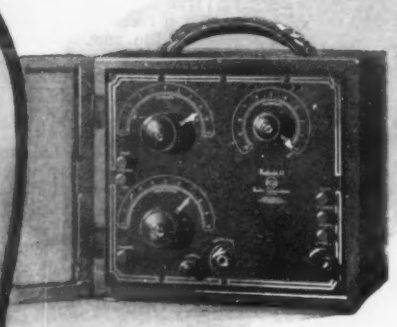
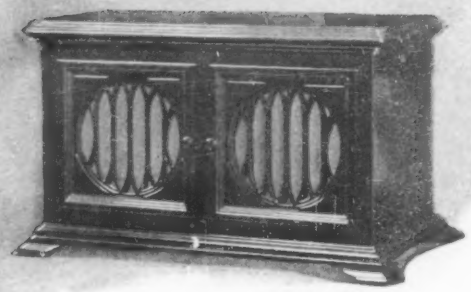


Radiola II



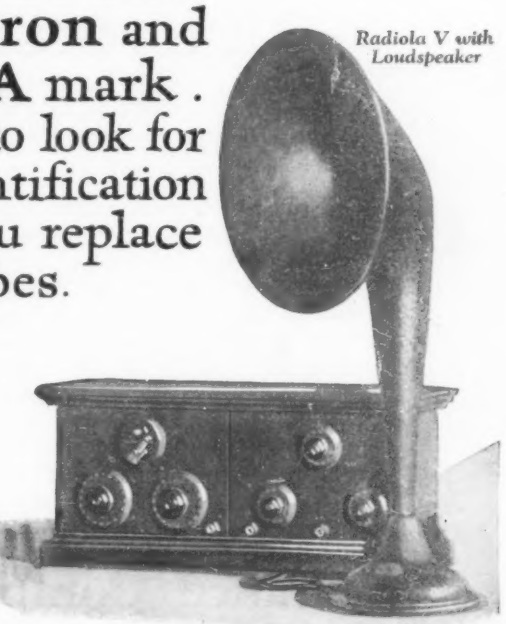
Radiola IV

In high quality receiving sets, the vacuum tubes — the heart of their fine performance — bear the name **Radiotron** and the **RCA** mark. Be sure to look for this identification when you replace your tubes.

RCA

This symbol of quality is your protection

Radiola Grand



Radiola V with Loudspeaker

Radiotron WD-11
Radiotron WD-12
Radiotron UV-199
Radiotron UV-200
Radiotron UV-201-A

Send for free booklet that describes all Radiotrons giving their characteristics and circuit diagrams.

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Sold but not delivered

YOU sell a bill of goods. You ship them. But the transaction is not completed until the shipment is *delivered.*

The wise shipper always covers his shipment with a Transportation Insurance Policy.

Such a policy insures your goods against the risks and perils of transportation, not only when in the hands of the railroad but upon trucks, docks, ferries and public platforms . . . from the moment of loading at shipping point to actual delivery.

A claim under a North America Transportation Policy will put you in funds promptly . . . always a great advantage in case of loss. Ask a North America agent or write to Dept. 15.

Insurance Company of North America

Third and Walnut Streets
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"The Oldest American Fire and Marine Insurance Company"
Founded 1792

Scientific American Digest

(*Continued from page 52*)

places visited on the Atlantic and Gulf coasts. The operators of a certain large fleet of tankers have developed what is believed to be a promising oil-water separating device for use on oil-cargo vessels. In the absence of separating apparatus aboard ship, the use of barges for collecting oil-contaminated water and oily refuse, in connection with adequate facilities for the proper treatment and disposal of such wastes, offers the most immediately available means for coping with the situation after the vessel has arrived in port.—*Nautical Gazette*, 105 :14, p. 372.

Water-line corrosion takes place over a narrow range at the point where the metal emerges from the liquid. Many theories have been advanced to account for this effect. The true explanation was suggested by a phenomenon frequently seen during the corrosion of metallic anodes by use of the electric current, where the dissolving of the metal creates a film of condenser solution next to the metal, which can be seen to flow down along the surface of the anode and stream off from its lower end. Water-line corrosion was thought to be due to a similar circulation which keeps all of the metal plate except that near the liquid surface in contact with partly exhausted solution, and causes the metal at the surface of the liquid to be bathed by the stream of fresh solution which is drawn in to take the place of that which flows downward along the metal surface. To determine if such circulation actually takes place in cases of water-line corrosion, a strip of copper was placed in a narrow stereopticon-cell containing normal sulfuric acid, to which fifty grains per liter of potassium bichromate had been added, and the corrosion process was watched by transmitted light. In a few minutes the expected circulation was clearly visible, and a constant stream of corrosion products flowed down the specimen and off the lower end.—*Chem. and Met. Eng.*, 29 :16, pp. 706-08.

The British Aircraft-Carrier Hermes, is the first aircraft-carrier in the world to be designed and built for the purpose of carrying naval seaplanes, other ships of the type having been converted from various types of warship. Roughly, she is 11,000 tons, with a speed of 25 knots, and an armament of seven six-inch guns, but the ideal which the naval constructor now has in view is a ship of at least 20,000 tons displacement, with a powerful battery, preferably of 7.5-inch guns. In the matter of speed, it is felt that the Hermes is too slow after the experience with the converted aircraft-carrier Campania, which showed that such a ship should be at least two knots faster than the man-of-war with whom she is operating in order to give her time to come into the wind to launch her machines without dropping right astern of her consorts and necessitating the detachment of destroyers for her protection. Similarly, the general opinion now is that 20,000 tons displacement is the minimum with which a carrier can expect to be operated efficiently if she is to pick up exhausted machines under service conditions.—*Naval and Military Record.*

Flying Tenders for Submarines.—The United States Navy has decided to fit all its ocean-going submarines of the "S," "T," and "V" classes with special small seaplanes. These air craft can be struck down and stowed on board a submarine or patrol vessel without difficulty. Should any naval Power in future warfare use under-water craft against merchantmen, the added danger of a flying tender can well be imagined, for there would be no longer any hope of eluding the enemy by dazzle-painting to disguise the course and speed of the ship, or by apparatus for concealing smoke, except, perhaps, in narrow waters, where the enemy would not dare to stay sufficiently long on the surface to get the seaplane away. The machine would not be used for bomb-dropping, but would probably follow the tactics of the seaplane tender of the German raider Wolf, which not only acted as scout and greatly increased her range of vision, but also flew on ahead and opened fire on her intended victim with machine guns, which generally persuaded her to stop and await the arrival of the raider. It would also mean a very considerable alteration in our war-time ideas of anti-submarine patrols, as little craft like motor launches would afford small protection against machine-gun fire unless they had so much steel armor that their speed would be seriously impeded.—*Naval and Military Record.*

Plibrico eliminates this!

WHEN furnaces are lined with fire brick, it is not long before the flame attacks the joints, causing the bricks to crack and spall. Soon they crumble and fall out, and the entire lining goes bad and allows heat to escape—just like the lining in the photo above.

Plibrico Furnace Lining eliminates this. Plibrico is pounded into place while plastic, and forms a jointless lining—a lining that lasts two to four times longer than fire brick, that resists heat to 3100 deg. F., and that cuts down heat radiation. It is ideal for ignition, front door and rear combustion arches and special shapes because it can be applied to any shape. Unskilled labor installs it—with mallet and trowel.

Plibrico is delivered only in steel containers of distinctive appearance as shown below. Warehouse stocks in over sixty cities in the United States and Canada: see phone books.

PLIBRICO
FURNACE LINING
JOINTLESS FIRE BRICK CO.
1159 CLAY ST. CHICAGO

Book Free

Ask for the 32 page "Refractories and Furnace Design." It will point the way to lower furnace costs and—greater profits.

Jointless Fire Brick Co., 1159 Clay St. Chicago.

Please send me the 32-page booklet, "Refractories and Furnace Design"—no obligation.

Firm .....

Address .....

.....

Name .....

Position .....

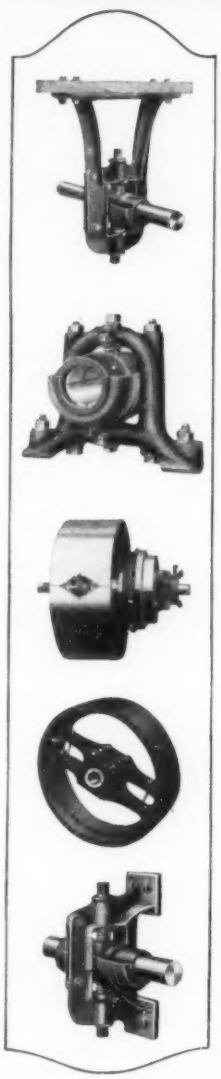
Sc. Am. 1-24

The new mechanical parcel post mail sorter consists of a rotary rack for the mail bags into which parcels are thrown by the men who do the work of sorting at the office of initial dispatch. In the past the racks have been fixed. In the new device the bags are attached to a rack which travels on an elliptical track. The sorters work on a platform alongside the rack. Mail is delivered to them by means of chutes from the receiving division of the office. The mode of operation is simple. Each bag is marked by a tag of conspicuous coloring. In the tests now under way at Chicago the tag for Ohio may be a brilliant red and that for Vermont may be green and white. Picking up a parcel for Ohio, the sorter spots a red tagged pouch and throws the package into its open mouth. As Ohio is near by, and receives a considerable volume of mail from the Chicago office, there are several bags for this one state, and it is certain that one of these will be near the sorter, involving no wait. On the other hand, Vermont receives relatively little mail from this office, and the green and white tag may be at the other end of the platform. In this event the sorter merely deposits the parcel on the shelf between him and the rack, and waits for the Vermont bag to appear. When the bags are divided into 60 designations, or "separations," as they are technically known, the speed is as great as when there are but 30. In using the stationary rack the speed decreases with the increase in the number of destinations. In handling large parcels the rotary rack is especially effective. Tests show that in eight hours the sorters filled 1500 sacks, ten parcels to a sack, at the rate of seven parcels per man per minute. This is practically twice as rapid as the handling of similar parcels by use of the stationary racks. The great saving comes through the elimination of lost steps on the part of the sorters, in walking from end to end of the racks on which stationary sacks are mounted. The rotary rack, with modifications based on the Chicago experiences, will probably be installed in all important postoffices.—*Manufacturers' Record*, 84:16, p. 87.

Rebuilding devastated Japanese areas will require, according to the National Lumber Manufacturers' Association, over a thousand shiploads of three million feet each to rebuild the devastated areas, and America is the only country that can quickly respond and whose output is equal to such a demand. The Japanese trade, according to the Association, formerly called for squares, ranging in size from 4 x 4 in. (10 to 20 ft. lengths) to 24 x 24 in. (24 to 40 ft. lengths), all in merchantable grade. The combined resources of British Columbia, Washington and Oregon cannot furnish over a billion feet of these sizes and grades in a year, says a prominent lumberman of the West Coast, and if the demand is as great as estimated, lower grades and sizes must be used. Reports to the U. S. Department of Commerce place the destruction of buildings at 316,000 in Tokio and 70,000 in Yokohama. At the time of the disaster large reserve stocks of lumber were stored in Kobe, Osaka, Tokio and other cities. The real demand, according to the lumber manufacturers, will come when the permanent construction of the devastated areas commences. Advices received from the Consulate General of Japan at New York, and made public by the U. S. Department of Commerce, state that by an Imperial ordinance building materials and necessities of life will be exempted from import duty until March 31, 1924.—*Eng. News-Record*, 91:16:660.

Methods of disposal of privy wastes in rural districts were investigated by the United States Public Health Service with interesting results. It was found that fecal bacteria, made visible with uranin dye, progressively followed in the ground-water for distances of 3, 6, 10, 15, 25, 35, 45, 50, 55, 60 and 65 feet from the trench in which the pollution was placed; uranin has been recovered from these same wells and has spread to other wells at 70, 75, 80, 85, 90, 95, 100, 110 and 115 feet from the pollution trench. The soil in question is a fine sand with an effective size of 0.13 millimeters. The pollution has traveled these distances within a period of 187 days, or about 27 weeks, and only in the direction of the flow of the ground-water; no convincing evidence is present that the pollution has traveled against the flow of the ground-water or at right angles to it. The pollution has traveled only in a thin sheet at the surface of the zone of saturation; there is no evidence at present that it has dispersed radially downward, and even when heavy pollution

At the Gutmann Tannery, Chicago



DODGE

Dodge Transmitting Units Are Giving *Plus Service*

For 25 years the power required to produce high grade leather manufactured by Gutmann & Company, has been distributed economically and without interruption by Dodge Power Transmitting Units.

Always when needed this Dodge installation has responded to the demand for 24 hour service and played an important part in maintaining peak production schedules.

Throughout this plant there are Dodge appliances which have stood the test of *Plus* service, many under heavy overloads, day in and day out, year after year. This is why the new Gutmann plant will be 100% Dodge equipped.

Dodge means power savings. Plants which have standardized on Dodge rank on the plus side of the ledger. Five hundred local dealers distribute Dodge products on the immediate delivery basis.

DODGE MANUFACTURING CORPORATION
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EVERYTHING FOR THE MECHANICAL TRANSMISSION OF Power

Branches: New York Philadelphia Pittsburgh Boston Cincinnati Newark Chicago Atlanta Minneapolis St. Louis Houston Seattle San Francisco

Industry's Demand for 24 Hour Service

Possibilities of peak or over-loads must be considered in equipping factories of today

An eight or ten hour day may be the rule insofar as man is concerned, but the machinery which multiplies the labors of man must be built to withstand the wear and tear of two or three eight hour shifts, day in, day out, through the years. The possibility of peak or over-loads must be carefully considered in placing orders for machinery of production.

Dodge Power Transmitting Units are built to withstand maximum demands from any industry in which they are called upon to function. Hundreds of Dodge installations have been doing 24 hour service six days a week without attention, and without retarding production in any manner. In the paper industry alone, Dodge sheaves, rope drives, clutches, bearings, hangers and pillow blocks are demonstrating the limit of dependability.

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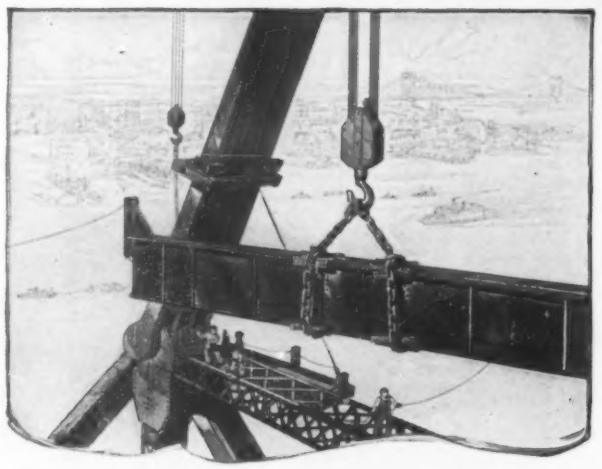

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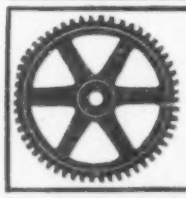

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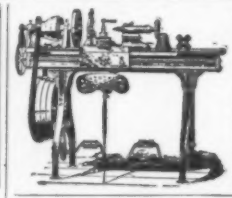

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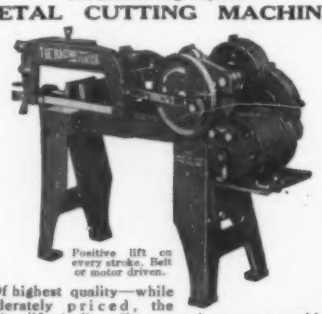

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is recovered at the top, water from lower levels (in near-by deeper wells) is negative both for uranin and for B. coli.—*Eng. News-Record*, 91:11:425.

Industrial Progress

Increasing the Diesel engine's thermal efficiency.—The most successful utilization of waste heat is that effected in the Still engine, in which steam raised from the jacket and exhaust of an internal combustion cylinder is applied on the opposite side of the piston. By such means the thermal efficiency has gained another 7 per cent, thus bringing the total up to 41 per cent. This engine has passed its experimental stages, and is now being manufactured as a four-stroke, single-piston, heavy-oil engine, in sizes up to 1000-brake horsepower for land purposes and 350 horsepower per cylinder for marine propulsion.—*The National Engineer*, 27:9, p. 420.

A gas apparatus designed to utilize fuel-oil distillate in the manufacture of gas for commercial and domestic purposes has been perfected at Buffalo. The new process is said to be more economical than the manufacture of coal gas, while the plant apparatus necessary in the making of gas from fuel-oil distillate is much lower in cost than coal gas apparatus. The gas produced, it is claimed, has five times the heating value of producer gas, contains no sulfur, and burns with a non-oxidizing and non-carbonizing flame. The gas has given satisfactory results in direct application to heat treating of ferrous metals and in japanning and enameling. Tests have proved the gas suitable for lighting and heating, and for domestic purposes, comparing well with coal gas in thermal efficiency. Four gallons of fuel-oil distillate are required per thousand cubic feet of gas. One attendant can operate a plant having 500,000 cubic feet capacity per 24 hours, hence the operating cost is low.—*Gas Ind.*, 17:9, p. 297.

The first Diesel-electric pipe-line dredge to be placed in service is being built in Portland, Oregon. This dredge has a fifteen-inch discharge and it is estimated that the saving in operating costs of this dredge, over a steam dredge of like capacity, will be as much as $15,000 a year. Instead of the customary direct-current drive, alternating current is used, so that if desirable, outside power can be used. The power plant consists of a 525-brake horsepower Diesel engine of six cylinders which is run on ordinary fourteen-degree Baumé fuel-oil. The main generator operates at 2300 volts.—*Motorship*, 8:8, pp. 558-59.

The first welded gasholder was fabricated in Melbourne in 1922. This tank is 200 feet in diameter by 105 feet deep and is built of 9/64-inch steel. When finished it contained some fifteen miles of welding and when tested with soap and water there were only six leaks. For some time oxy-acetylene welding was employed, but was ultimately discarded as unsuitable largely owing to the difficulty of overhead welding. Attention was then directed to the use of electric welding and 250 experiments were made to test various types of joints and electrodes. Ultimately that employed was the quasi arc process. From the tests, the tensile strength of the joints was invariably found to be equal to, if not greater than, the sheets themselves.—*Gas World*, 79:2047, pp. 325-27.

The Young-Whitwell backrun gas process is a new development in the art of manufacturing illuminating gas which was brought about largely through the desirability of using cheaper fuels, and at the same time utilizing equipment already in existence. Through slight changes in the construction of any ordinary water-gas set, this process renders available as generator fuel either coke or bituminous coal. Remarkable results have been obtained when slack bituminous coal and heavy oils have been employed. The operating economies provide for the substitution, pound for pound, of slack bituminous coal for coke. Its improvements over the old methods and equipment and its marked operating savings depend upon utilization of cheap fuel, lessening of heat loss, reduction in maintenance and depreciation, decrease in gas-oil used to give a required thermal value, elimination of the expensive and complicated hot-valve and small capital outlay in installation. The process is applicable to any water-gas set, after certain changes.—*Chem. and Met. Eng.*, 29:15, pp. 664-69.

A new compound fertilizer which is manufactured by a French company is based on the idea of neutralizing the residual acid-

(*Continued on page 58*)

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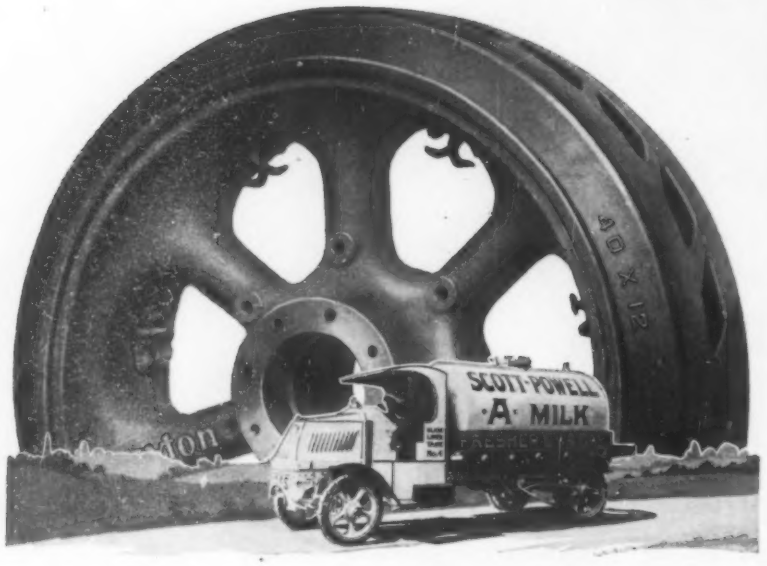

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Scientific American Digest

(*Continued from page 56*)

ity of ordinary super-phosphate with ammonia gas. By utilizing the ammonia gas in low concentration—say, three to five per cent—and carefully controlling the temperature of the reaction, not only can the previously recognized danger of retrogradation of the phosphoric acid positively be averted, but the resultant compound fertilizer is obtained in a perfectly dry and friable condition, and a homogeneity much greater than that of simple mixtures. In this process a saving of 48 per cent of sulfuric acid is claimed.—*Chem. Trade and Chem. Eng.*, 73:1897, p. 360.

A new type of boiler furnace designed to operate with pulverized fuel has been developed, in which a combustion rate many times in excess of the rate recommended at present has been maintained. This furnace is known as the Cannon radiating furnace. As much as 60 per cent of the total heat of combustion will be delivered to the boiler by radiation at a combustion rate of 250,000 B.t.u. per cubic foot of combustion space per hour. Each furnace will be fed by a single, simple, straight pipe-burner located in the wind-box at the front. Pulverized coal will be carried from the feeder to the burner at a suitable velocity by means of low pressure air. This furnace will operate under forced draft. The flame starts in the lower chamber just a few inches beyond the burner-tip and extends to the rear, thence upward into the rear of the top chamber and back to the exhaust opening. Thus the flame passage is double the boiler-tube length under normal conditions, while the cross-section of the gas-stream in the furnace is small compared to the total length. This produces a very continuous mixing of the combustible matter with the oxygen, and because the walls surrounding the gas-stream are at a high temperature, makes it possible to burn the fuel rapidly and with a minimum amount of excess air. When surrounded with water-absorption surfaces, the exterior of the furnace surface will be at 1600 degrees F.—*Combustion*, 9:4, pp. 307-11.

A record of 450 rivets in a working day of eight hours has been the average performance of the bull riveter in use on the penstock work on a power tunnel at Niagara Falls. This is the same riveter which the artist used as his inspiration for the cover design of the November issue of the SCIENTIFIC AMERICAN. On a regular run, 45 rivets in 35 minutes was the schedule. The saving in labor effected by the riveter is computed at 66 per cent. The average work of a crew of seven men hand riveting is 150 rivets in an eight-hour day. With hand-driven rivets a percentage must be allowed for cutting out loosely driven rivets—a condition not found in the machine-driven work. The rivets used on the penstock job were 1½ inches in diameter.—*The Boilermaker*, 23:9, p. 258.

Experiments on the dry-cleaning of gas with dust which were conducted at the Pittsburgh Steel Company plant during the past summer show the great possibilities of this method of purification. As a result of these tests it is believed that beyond the dry cleaner lie tremendous possibilities as a result of its use. In the nature of conservation of sensible heat of the furnace gas there is better combustion in stoves and boilers, with resultant decrease in power costs, due to elimination of labor in upkeep and repair of equipment as a result of complete recovery of flue dust. This, at the average furnace, where no special attempt is made or ineffective means are employed to recover the dust, may run as high as 60,000 tons per year. The extremely low dust content of gas cleaned by this method makes it possible to clean that part of the gas to be used by gas engines, by passing it through an indirect cooler in which the gas is cooled and the moisture condensed, bringing down with it the remaining dust, thus accomplishing complete cleaning and recovery of the last trace of dust without bringing the gas into direct contact with water.—*The Iron Age*, 112:17:1111-14.

Metallurgy

Red stains on sheet brass are found to be caused by reactions of copper oxides in the scale formed during annealing, and the pickling medium, cupric oxide, contrary to usual opinion, is as harmful as cuprous oxide. Oxides of copper may be present from various causes, such as careless washing after the pickling operation, resulting in the presence of acid and salts during the subsequent annealing, the presence of iron in the brass

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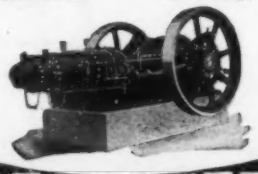

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or upon its surface and the use of impure rolling oils. However, the main cause of the oxidation of the copper is the use of the old-fashioned annealing furnaces, in which the flames impinge directly upon the brass.—*Metal. Ind.*, 21:10, p. 394.

Effect of temperature on the tensile strength of steel.—An increase of temperature of steel results in a decrease of tensile strength. But it is not so generally known that there is first a lowering and then an increase of strength during the early stages of heating. The average temperature at the maximum strength for all the steels is about 540 degrees, and the average for the lowest, prior to reaching the maximum, is about 220 degrees. So that it may be stated, roughly, that the tensile strength of ordinary steel is at its minimum at about the boiling temperature of water and that it reaches its maximum at about 550 degrees Fahrenheit. After this last temperature has been reached there is a steady fall in strength as the temperature rises, until when 1600 degrees, or a cherry red heat, is reached the strength has been pretty well lost. All steel-cutting tools hold their edges better when heated above the temperature of the atmosphere than when worked cold. A razor shaves better if raised to a little above the blood temperature. A finishing tool will cut more smoothly when warmed.—*Railway and Loco. Eng.*, 36:10, pp. 308-9.

The addition of 5 per cent of nickel to a 5 per cent chromium steel practically produces a steel which is almost resistant to nitric acid, while as regards hydrochloric acid, the addition of nickel very materially increases the resistance. As regards sulfuric acid, the gradual increase in nickel content is responsible for the production of a steel which is only very slightly soluble. Two other steels, consisting of a 10 per cent chromium steel without nickel and one with a 5 per cent addition of that element, show a marked increase in resistance to sulfuric acid, owing to the addition of nickel. The hydrochloric acid results are apparently in the opposite direction. The general effect of the addition of nickel to a chromium steel is to increase the resistance to nitric acid, to materially increase the resistance to sulfuric acid and to tend to increase the resistance to hydrochloric acid. The addition of such a comparatively small percentage of chromium as 5.05 per cent has a profound effect in modifying the response of the steel to nitric acid, and in materially reducing its solubility in hydrochloric acid.—*Engineering*, 116:3013, pp. 415-16.

The spangled surface of galvanized metal has always been a goal sought for by manufacturers of galvanized iron goods. Various causes have been blamed for failure to secure this result, but researches recently made show that the base-metal, iron or steel, has practically no influence on the result if the temperatures are satisfactorily maintained. Pure zinc did not yield the desired large spangles, and tin or aluminum likewise failed; but the addition of lead did so immediately. The separation of the impure zinc forming the layer on the metal sheet into conjugate solutions—lead-rich and zinc-rich—at the dipping temperature, and the method of subsequent crystallization were the causes of the effects obtained. This was proved by the analysis of different types of spangle occurring on the same sheet and by the observed differences in the rate of attack of different spangles forming the coating. The separation is attributed to the difference in the surface tensions of the two solutions.—*Metal Ind.*, 21:10, p. 394.

The density and composition of metals and alloys under two rates of cooling, fast and slow, as produced by casting in chill and sand molds.—The densities of pure metals are not affected by the rate at which they solidify. This is also true of those alloys which solidify at a constant temperature. In the case, however, of those alloys which solidify over a range of temperature, the rate at which they pass through this range seriously affects the density, the slower the rate of solidification the lower being the density. When alloys which possess a long solidifying range are prepared in cylindrical chill molds they are less dense in the center than at the outside. Rapid solidification has a pronounced effect on the composition throughout the mass of those alloys which solidify over a range of temperature. When prepared in chill these alloys are found to be richer on the outside in the component of the lower melting point and richer in the center in the component of the higher melting point. Sand castings in these alloys are uniform throughout. Alloys which solidify at

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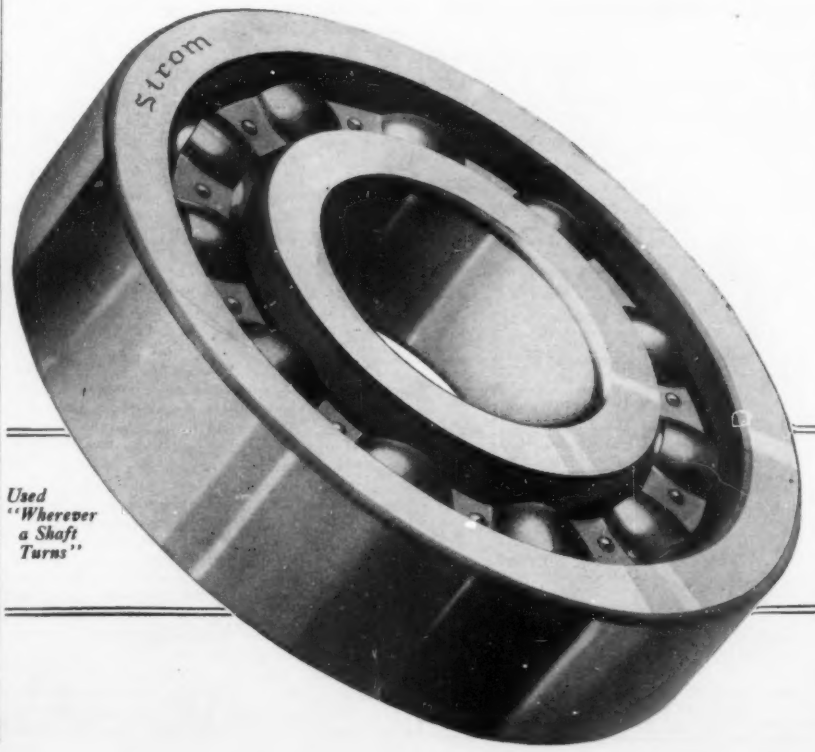

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GENERAL ELECTRIC

a constant temperature are uniform in composition throughout, whether prepared in sand or chill molds.—*Metal. Ind.*, 21:10, p. 395.

The corrosion of metals is found by experiments to be mainly, probably entirely, electrochemical in character. There are two main types. That accompanied by evolution of hydrogen gas is characteristic of reactive metals placed in acid solutions, but the velocity varies greatly with the degree of purity of the metal. Where this type is impossible, slower corrosion can take place at a rate determined by the diffusion of oxygen to the metal, and comparatively independently of the purity. When a metal is immersed in a solution of potassium chloride one can observe the production of alkali at the cathodic portions, the production of the chloride of the metal at the anodic portions, and the precipitation of hydroxide where these meet. The electric current, when measured, accounts for the greater part of the corrosion. Generally the cathodic areas are those to which air has free access, while the anodic areas are those protected from aeration, and it is significant that corrosion usually proceeds most rapidly at the comparatively unaerated places—hence the intense corrosion observed in the form of pits and over areas covered up by porous corrosion products.—*Metal Ind.*, 21:10, p. 396.

Electricity gaining ground in metallurgy.—The first electrolytic iron plant in the United States was started less than a year ago in Connecticut, and the subject has attracted considerable attention, inasmuch as a very pure iron can be produced in this way, and the smaller the undesirable impurities in iron the less it will rust. There are three distinctive ways that electricity is now used in metallurgy: first, for heat-treatment of ores and ore products in electric furnaces; second, for depositing the metals from solutions obtained by leaching the soluble constituents of an ore; and, third, for the refining or separating of metals already essentially free from undesirable elements. Some of these applications have not yet reached commercial importance so far as certain metals are concerned, but there is little doubt that development will be rapid.—*Eng. and Mining Jour.-Press*, 116:14, p. 575.

A new method of hardening high-speed steel has been developed by a Chicago manufacturer which obviates many of the difficulties of the former method, especially that of getting the correct method of heating the parts to be hardened. The tool is heated in a protected atmosphere for a predetermined time and temperature, and is cooled and drawn at a predetermined time and temperature, which results in the full development of the cutting structure throughout the entire piece at the lowest possible temperature. It has been determined by carefully conducted experiment that the complete carbide transformation is obtained in the standard modern high-speed steel at between 2200 and 2210 degrees Fahrenheit when held accurately between those temperatures in a protected atmosphere for a sufficient time to complete the change. The tools are placed in a container of a special alloy, surrounded by charcoal, and covered. The box and contents, after pre-heating, are raised to a temperature within the critical range where the carbide transformation takes place and held there a sufficient length of time to complete the change. The resultant tools are stronger and have several times the cutting efficiency. The method guarantees against overheating of the cutter, tool or part and the protected atmosphere assures the material being hard up to the very surface. It also corrects materials which are somewhat out of balance and consequently have a prolonged "lag."—*Forging-Stamping-Heat Treating*, 9:9, p. 375.

Chromizing consists in packing the material to be treated into a powdered mixture of 45 per cent alumina and 55 per cent chromium. The material is usually packed into a tube of iron and then heated at 1300 to 1400 degrees Centigrade in hydrogen, in vacuum or in some neutral atmosphere, for lengths of time depending upon the penetration and concentration of chromium desired. The chromatizing furnaces consist of alundum tubes wound with molybdenum wire as a heating unit. The non-corrosive chrome-iron alloy is a solid solution of chromium in iron, and is made up of an area of elongated grains, with their longer axes perpendicular to the surface. In order to get the best results, an iron or steel of low carbon content must be used. In cases where the material chromatized must stand high tension and fatigue stresses, the high temperature of

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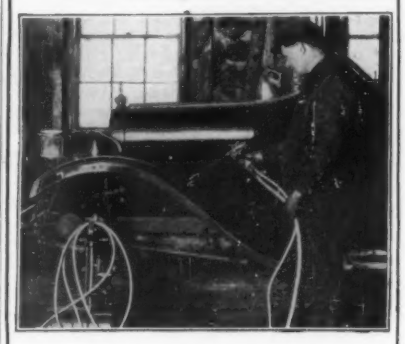

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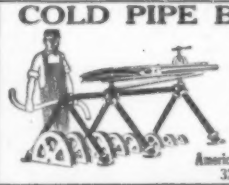

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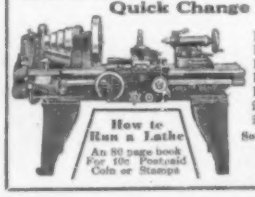

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chromatizing lowers the resistance of the material, but by proper heat treatment the original properties may be almost restored. Carbonizing of chromatized iron lowers its resistance to corrosion, and polished samples which have been case-hardened will show numerous globules of water if allowed to stand in the open air for only a short time.—*Brass World*, 19:9, pp. 291-92.

Mining

The question of the origin of petroleum is very complex. In many cases we have reason to believe that the petroleum was not formed in the strata in which we find it. The bulk of the oil of a field may have been produced under fairly uniform conditions; but each minor occurrence may also have passed through its own history of production and development under special local conditions. As regards parent material or materials, we have only suppositions. The oils—as distinct from petroleum—we commonly deal with are all of organic origin, vegetable or animal. Petroleum may have the same origin, and of late the view has been gaining ground that the occurrences of petroleum and coal are interrelated. But the advocates of an animal origin of petroleum have by no means given in; the possibility of an inorganic origin also continues to find support, and the great variety of petroleums suggests various parent materials and modes of production. At present there is no agreement, not even on essential points.—*Engineering*, 116:3015, pp. 466-67.

Pollution of public water supplies by mine drainage has become a serious matter in some parts of the country, particularly in the bituminous districts of Pennsylvania. Sulfur and iron appear in the coal in the form of pyrites, which, coming in contact with air and water, causes chemical changes which produce an acid drainage. Coal in situ has no effect on the quality of the water in the streams on which it outcrops. It is the impurities, such as iron and sulfur, in the coal coming in contact with air and water after mining is started that produce chemical changes which result in the formation of acid drainage. Before mining is started, the coal in place and undisturbed acts as a barrier to the percolating waters above and prevents the water and air from coming in contact with the impurities, and for this reason a virgin field of coal has no detrimental effect upon the purity of the streams. It is believed that the added expense of treating mine water would not exceed ten cents per ton of coal mined. It is suggested that, to obviate the necessity of treating the mine water from abandoned mines, or at least to have the volume of such drainage reduced to a minimum, it should be unlawful to mine any coal within the area included between the outcrop and the line of 20-foot cover.—*Eng. News-Record*, 91:16, 638-41.

The outstanding feature of the development of technical practice on the Witwatersrand during the past few years has been the adoption of what may be termed the all-sliming process. This process may be briefly described as single-stage crushing in conjunction with improved methods of tube milling. On account of the relatively small capital cost involved in the plant and the high percentage of extraction that is possible, it is thought that the process offers great possibilities to the small man, it being possible to provide a unit plant capable of handling from two to three thousand tons per month. It is designed to recover either by blanketing, amalgamation or cyaniding at a very considerably lower cost than would be incurred with the usual type of plant.—*S. African Min. and Eng. Jour.*, 34:1667, p. 775.

Prospecting with the Eötvös balance.—The value of this instrument consists in measuring the extremely small changes in gravity caused by lighter or heavier masses in the earth's crust. The instrument is so sensitive that it enables one to measure differences in the force of gravitation with any accuracy exceeding many thousand times that of the most analytical scales. In principal it is identical with the torsional balance first used by Coulomb to investigate the laws of static electricity. In Germany a concern has recently been making these instruments, whose readings are made automatically by photographs, and a few are now in use in the United States and Mexico. It requires the handling of an expert and is not reliable in hilly country, but is best adapted to oil, salt and coal fields.—*Eng. and Mining Jour.-Press*, 116:14, pp. 583-89.

Transporting marl with compressed air is an ingenious new method used by a Michigan cement plant for conveying their material from the source of supply two miles distant from their cement plant. The marl is dug by means of an orange-peel bucket dredge and deposited in a separator for the removal of roots, pebbles and foreign matter which might clog the pumping system. The air is compressed in a compresser driven by a 75-horsepower motor. Two circular steel tanks, five feet in diameter and five feet high, located next the storage vat, are connected with the receiver and compresser through an automatic switch which operates in such a manner that air is drawn from one steel tank forming a vacuum and causing the agitated marl slurry to rush into this tank, filling it, while the other tank is placed under discharge. The twelve-inch pipeline to the mill is 10,000 feet long and has two relay stations, with receiving vat, compresser and pumping station. No difficulty is experienced in transporting the marl the greatest relay distance of 4,400 feet with a difference of elevation of 30 feet, using 75 to 90 pounds of air pressure. Marl slurry containing 50 per cent moisture can be pumped effectively.—*Cement and Eng. News*, 35:8, pp. 34-36.

Platinum in the United States.—The main source of the world's supplies of platinum is normally Russia, which once had an output of 300,000 ounces per annum, derived from gravel beds. As a result of the war the price of platinum is about three times what it was formerly, and the temptation has been considerable in this country to boom platinum mining. To this end, all sorts of properties have been pronounced to be capable of producing platinum from ores of various kinds, and even shales and sands. As a matter of fact, this country is practically destitute of platinum, as it is of nickel and tin, and the cases in which the United States Bureau of Mines has been able to check claims advanced have revealed at the most practically unworkable traces of the metal. Platinum was the subject of a good deal of prospecting and assaying on the part of the Bureau during the war, when it was thought that such work might reveal sources of supply which would then have been very valuable. The work then and since carried out served for the most part to convince the officials that the platinum resources were, however, very small. At its best the United States has produced less than 1000 ounces a year, and that as ancillary to the working of gold, silver and copper, without which the platinum recovery would have been uneconomical. The Bureau's investigations have led to the examination of a large number of samples, in most of which no platinum whatever was discovered, though rich claims had been made and certified. In one case platinum was found in the form of soluble platinum salts and sponge, "neither of which exists in nature," to quote the damaging judgment of the Bureau; another "sample revealed wire and foil therein."—*Engineering*, 116:3006, p. 187.

Mining Engineering

Holding machine work by vacuum.—To provide for holding large quantities of small pieces made of either ferrous or non-ferrous metals, and non-metallic work, such as rubber, fabric, wood or glass, a Detroit (Mich.) company, after considerable experimenting, has developed a line of chucks that utilize vacuum for holding work. In each of these vacuum chucks there is a chamber which is made air-tight when the work is placed over it, either by the work covering the entire surface or by other means. A vacuum is then created by pumping all the air from the chamber, and as this is done, the work gradually becomes secured to the chuck by atmospheric pressure. As atmospheric pressure is approximately 14.7 pounds per square inch, at sea level, a piece, say, 4 inches long by 1 inch wide (provided full vacuum has been created and practically the entire bottom of the piece is exposed to vacumm) will have a downward pressure of almost 60 pounds, tending to keep it from slipping on the chuck as the cutter is applied. When full vacuum has been created, the limit of holding power is obviously reached, and the pump then simply operates to maintain this vacuum.—*Machinery.*

A resume of the progress made in centrifugal casting shows that the principal commercial application of the process until recently has been in the casting of large cylinders of considerable length, in non-ductile alloys, such as red brass, aluminum alloys, etc. Cylinders of twenty feet or more in length and 2000 pounds in weight have been made without difficulty. During the war,

(*Continued on page 64*)

U. S. S. COLORADO
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Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

A Capacity Finder has been introduced by a manufacturer of radio condensers. This consists of two strips of metal across which are bridged five fixed condensers of different capacities. The two strips are connected with the grid circuit, and it then becomes possible to try various capacities until the best results are obtained. The device is then removed and a fixed condenser of the desired capacity is put in its place.

Variable Resistance and Capacity for grid control are provided in a single device which has recently appeared on the market. The resistance may be varied in a gradual and positive manner from one-fifth to twelve megohms, while the capacity may be gradually varied from .000002 to .005 mfd., according to the manufacturer. It is said by those who have employed this grid control that signal strength is increased 25 per cent in the case of critical circuits, such as the Reinartz.

New Radio Circuit for Poland.—October 4th marked the opening of direct radio communication between New York and Warsaw, the station of the Radio Corporation of America working with the new Polish Government station just completed in the latter city. This makes the seventh direct circuit to Europe operated from New York City. The importance of this communication to the two countries concerned is indicated by the fact that during the calendar year just past 71 per cent of the total international telegraphic traffic of Poland was with the United States.

The Riverhead Receiving Station of the Radio Corporation of America was planned for a capacity of nine receiving sets, so we learn from a paper recently read before the American Institute of Electrical Engineers. Of these, six are now in daily operation. Mutual reactions are minimized by careful screening of the various component elements and by the astatic winding of coupling coils. In addition a two-stage filter is introduced in each circuit between the detector and the audio-frequency amplifier. These precautions have made it possible to operate the several sets with the same filament and high-tension batteries, without trouble from back coupling.

The Trans-Atlantic Broadcast Tests formed an interesting feature of National Radio Week, which was observed from November 25th to December 1st. Various broadcasting stations abroad, and likewise here, were connected together by land line so as to function as powerful units, from a common microphone. Our leading broadcasters were intercepted by British amateurs, just as British stations were intercepted by American amateurs. Nevertheless, the fact remains that trans-Atlantic broadcasting reception requires the most elaborate type of super-heterodyne receiving sets, which are available to only a very small number of amateurs.

The Autoplex Circuit is the latest to attract the attention of those who like to build their own sets and who are forever seeking something different. The autoplex circuit is, in reality, a super-regenerative set. It makes use of two standard variometers, one for the grid and the other for the plate; an L-1250 coil in the antenna-ground circuit; a filament battery, rheostat, and vacuum tube; and the usual "B" battery and telephone or loud-speaker. Indeed, the autoplex will operate a small loud-speaker without amplification, which makes it rather unique among the usual run of receiving circuits. As it now stands, it appears that the autoplex circuit is by no means a polished product. Unless it is properly constructed and manipulated it produces distorted sounds. Nevertheless, it represents some interesting experimental possibilities for those interested in the experimental side of radio.

Transmitting Efficiency.—In no branch of radio telegraphy has greater progress been made during the last two or three years than in the design of the grounding systems of large transmitting stations, according to Prof. G. W. O. Howe, writing in *The Electrician*. For many years the effectiveness of a station was judged by its so-called power in kilowatts, which sometimes was supposed to represent the power actually supplied to the aerial, but more often represented the power supplied by the dynamo or alternator to the transmitter. The power actually radiated from the aerial was rarely considered, though this, after all, was the only thing that mattered. It is now fully realized, however, that the only measure of the effectiveness of a station is the radiated power, and since, for a given frequency, this depends on the product of the effective height and current, this product is now specified, instead of a meaningless number of kilowatts. To obtain the maximum radiated power for a given total power delivered to the aerial, every effort is now made to reduce the various losses. These consist of the losses in the aerial wires, tuning inductances, etc., and in the towers, stays, etc., losses due to brush discharge from the wires, and last, but by no means least, losses in the earth under the aerial.

Why Radio Signals "Fade."—For several years back the Bureau of Standards has been engaged in experiments aimed at ascertaining the cause of "fading" radio signals. The Bureau conducted tests during 1920 and 1921, with the cooperation of the American Radio Relay League. In these tests, states the Bureau of Standards, from five to ten radio stations transmitted signals in succession on certain nights, according to prearranged schedules. The signals were received simultaneously by about 100 receiving stations whose operators were provided with forms for recording the variations in the intensity of the signals as received. The general result of these tests substantiates the theory that the sources or causes of fading are intimately associated with the conditions at the heaviside surface, which is a conducting surface some sixty miles above the earth. Day-time transmission is largely carried on by means of waves moving along the ground, while night transmission, especially for great distances and short waves, is by means of waves transmitted along the heaviside surface. Waves at night are thus free from the absorption encountered in the day time, but are subject to great variations caused by irregularities of the ionized air at or near the heaviside surface. These variations probably account for fading.

The Sodion Detector Tube, invented by H. P. Donle, chief engineer of the Connecticut Telephone & Electric Company of Meriden, Conn., has now made its bow to the radio public. Several years ago we described in these columns the interesting development work on vacuum tubes being conducted by Mr. Donle, and more recently we told of his latest tube, involving the use of a sodium element. The characteristics of the present commercial product are quite similar to those of the former experimental tube. The present form differs in that no liquid sodium electrode is used. The outstanding features claimed for the sodion tube are high sensitiveness (about two stages greater than the hard grid tube detector), pure quality of tone production, stability in operation and absence of all interference-producing squeals and whistles, as the tube cannot be made to oscillate or regenerate in itself. Like the previous type, we learn from *Electrical World*, this tube has no grid, but utilizes a trough-shaped piece of nickel, partially surrounding the filament and open toward the anode, as its control electrode. A glass shell contains the anode or plate, the filament and the collutor or control electrode. A heater is wrapped non-magnetically around the outside of the tube and a second external glass shell is placed over all elements for protection and to conserve heat. The tube is pumped to the highest possible vacuum and internally treated with an alkali metal (sodium) to provide the stable ionizing material that plays an important part in its sensitiveness.

A New Sound Amplifier.—To amplify the sound of a voice so that many persons may hear it throughout a large room, various methods are possible, utilizing properties of flames, compressed air, electrical currents, etc. Writing in a recent issue of *Comptes Rendus*, L. Graumont states that the sounds

are, in general, distorted because of the mass of the vibrating parts which serve to reproduce and transmit the sound. M. Gueritot recently suggested a new electrical arrangement, which resolves all the problems of voice transmission. The vibratory part is formed by a cone of fine silk, on which is spirally wound a very fine wire conductor, preferably of low density, *e.g.*, of aluminum. This cone is placed between the poles of an electromagnet, the poles being shaped exactly to fit the cone, and a circular collar fixes the base of the cone to one of the poles. Telephonic currents are passed through the winding of the cone, and under the action of the magnetic field it is set into vibration, and, having practically no natural oscillation, it has no difficulty in reproducing the sounds which have caused the electrical currents. To allow the transmission of the sounds so produced a number of orifices are present in one of the pole pieces, and these orifices are at the apex of the horn. It is stated that with such an arrangement the voice may be heard in a large room, and with the aid of the vacuum tube amplifier orders can be given verbally above the noise of a machine shop. For outdoor use it can be employed from ship to ship or ship to shore, and in railway yards.

A Receiving Tube with Alternating Current Filament Heating has been worked out. The special feature of this tube is the cathode unit. This consists of a cylinder of nickel, coated with a mixture of barium and strontium oxides. The material is 0.003 inch thick, and the complete cylinder is ⅞ inch long, with an inside diameter of approximately 0.08 inch. The heating element is a filament of tungsten 0.0035 inch in diameter and 2 inches long, in the form of a V with the sides parallel and about 0.010 inch apart. To maintain the relative positions of sleeve and filament and to insulate the sides of the filament from one another, a tube of refractory insulating material is used. This tube has an outside diameter of 0.085 inch and is pierced with two longitudinal holes 0.005 inch in diameter and 0.010 inch apart. The cathode sleeve is supported at the top by a strip welded to it (leaving the filament free at the top), and a lead is brought out from this strip so that the connection can be made to the cathode quite independently from the alternating-current supply leads to the filament. The grid is a helix of nickel wire, and the anode a nickel cylinder ¾ inch long and ⅜ inch diameter. The tube operates with an alternating current of 0.85 ampere at about 5.5 volts. The hairpin construction of the filament eliminates the effect of the magnetic field due to the filament current by opposing the fields of the two parallel sides. The mass of the cathode renders temperature variations negligible, and the separate connection to the cathode sleeve eliminates the hum usually heard when alternating current is used and due to voltage drop along the filament.

Theater Broadcasting.—The heart of the "direct wire" system used by Broadcast Central in New York City for the broadcasting of programs directly from theaters and other places is composed of three main arteries. In addition to these three arteries, there are nine additional permanent wires. Various other net works of wires are tapped off, and lead to the station from the main circuits. This artery system enables Broadcast Central to reach many points and affords the radio audience a multitude of concerts, talks and plays. When a theatrical production is to be broadcast, a member of the program staff is detailed to review the play about a week in advance. If the play has enough of its success in the songs and lines, it is considered a suitable radio subject. About two days before the broadcasting date a wireman installs the necessary backstage wire connections, which are, of course, temporary in the case of the theaters. On the afternoon of the date set for the performance the outside crew set up their equipment backstage. The microphone is concealed in the footlights in most cases, but may be suspended above the stage. Everything is in readiness by the time the first of the audience arrives, and the announcer then arrives and begins by introducing the theater audience to the radio audience. The announcer generally has a microphone just back of the scenes, so as to be in close touch with all that goes on. Occasionally, the announcer is given a small dressing room, with interphone communication with the stage. As soon as the performance is over, the microphones are removed. Certain installations, such as that in St. Thomas's Church, are permanent.

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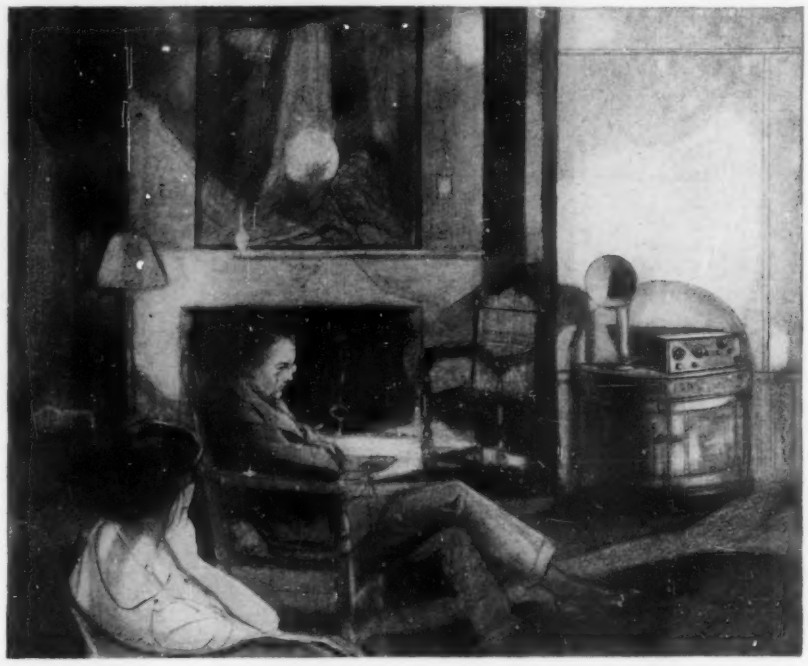

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—*From "The Hair Apparent," Part I., Chap. IV.*

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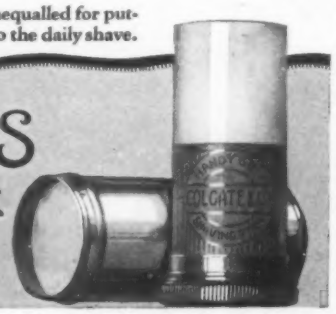

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Scientific American Digest

(*Continued from page 61*)

Ford cast the Liberty motor bearings centrifugally. Bearings for Diesel engines were cast centrifugally by the Brooklyn Navy Yard, and these same bearings were babbitted centrifugally. The most important application of this process at the present time is in making cast iron pipe. The use of high temperature moulds has increased the life of the moulds used. The sudden heating of a mold from room temperature to 1500 degrees Fahrenheit or higher subjects it to enormous stresses and results in checking or cracking of the mold in a short time. Linings of sand or various cements have also proved valuable.—*The Foundry*, 51 :20, p. 825.

Diesel engine manufacturers, even those whose motors have proved their complete success at sea, are all carrying out much experimental work, with a view to developing new and improved types. After a period of prolonged experiments, a new type of Diesel engine has been placed on the market which operates on the two-cycle principle and employs crank chamber compression, although the 200-horsepower four-cylinder size is built alternatively with separate scavenging pumps. The main point of importance in the design is the elimination of the injection air compressor. A mechanically operated pump delivers the fuel to a special type of valve in the cylinder head. This is automatic, so that there are no mechanically operated valves, while the fuel pump works at low pressure, since the oil is delivered to the valves at the commencement of the compression stroke. This engine, on trials has shown a fuel consumption of about 0.41 pound per brake horsepower hour. —*Marine Engineering*, 28 :10, pp. 599-601.

Steel casting.—Some investigators are of the firm opinion that the trend of the steel casting industry is gradually but surely toward making the bulk of steel castings in green sand and the remainder in cores; that practically continuous molding and pouring will be the logical result of this trend, and that the day is not far distant when both of these ends will be realized.—*The Foundry*, 51 :19, p. 791.

An oil-fired crucible foundry furnace shown at the Hamburg convention of the German Foundrymen's Association attracted considerable attention owing to its advanced design. Instead of the usual sheet, this furnace is enclosed in a perforated metal shell which, it is claimed, has increased the radiating area at least 100 per cent. This has a tendency to keep the air cool in the immediate vicinity of the furnace. Oil and air for combustion enter the body of the furnace through the hollow trunnions on either side. The compressed air is passed through an air chamber immediately below the melting chamber and is cooled, while the air is heated to a certain extent before it enters the burner nozzle. The oil stream is thrown against a strainer and atomized. The flame from the burner enters the melting chamber around the plate supporting the crucible and rises around the crucible itself. Hence, metal in the bottom of the crucible melts first and gradually moves upward until the entire charge is melted.

In the development of precision grinding machinery in central Europe the influence of American designs is apparent. The widespread advantages to be derived by grinding were not appreciated fully before the world war, but since that time the economic value of abrasive tools has been realized and grinding is steadily taking the place of other machining methods. In the United States, where engineers have had the benefit of years of experience, grinding machines have been developed to a high degree of perfection and European machine-tool builders, realizing this fact, have in many instances taken licenses for manufacturing tools after American designs. Plain and universal cylinder grinders, especially for tool room work, have been developed to quite an extent, while surface grinding practice is still in the development stage. Emery is used to some extent for grinding wheel manufacture on the continent, owing to the proximity of raw material supplies, but the artificial abrasives, carbide of silicon and artificial corundum, sometimes referred to as iron-free emery, are used more extensively as their advantages are apparent. Europe is the birthplace of artificial abrasives, although they owe their greatest development to American genius.—*Abrasive Ind.*, 4 :10, pp. 283-85.

(*Continued on page 67*)

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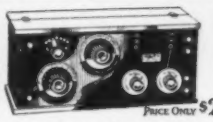

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Traffic and the Law

(*Continued from page 19*)

Massachusetts, because of the smaller volume of traffic; but it seems more likely that, as a general proposition, road conditions go down as traffic becomes less, making approximately the same maximum speeds appropriate all over the land. Certainly it is very bad to have the published limit absolute in some regions and discretionary in others.

A point which eight states have recognized would well be given attention by all. In overtaking a car ahead and in executing certain other maneuvers, the faster we move and the quicker we get it over with, the less of the road is it necessary for us to preempt. So Virginia requires that an illegal speed be maintained for an eighth of a mile before it becomes an offense; Delaware, Massachusetts, Minnesota and New Hampshire give the driver a quarter-mile grace; while Florida, Louisiana and Missouri allow him to burn up the road for a half-mile before his speed becomes, of itself, a matter for police interference. Where a similar provision is extended to the lower limits in towns, etc., the distance allowed is usually smaller than that on the open road.

Divergence in the lower limits is even wider and more confusing than in the general limit. A good deal of the terror is taken out of this situation, however, by the provision made in most states that such lower-limit zones must be posted. This provision, however, is not universal; and in its absence it is impossible for the visiting motorist to identify the restricted zones. Some states regard the limits of an incorporated city or town as the defining element here. Others attempt to define "built-up" and "closely built-up" regions, in terms of the average distance between houses, and to prescribe median and low speeds, respectively, therein. Residence and business districts are another basis for the same thing in numerous states. Practically all states have a very low limit, somewhere from four to twelve miles, for places which the writer defines in his own mind as "traffic points"; but there is no unanimity in their definition by the laws of the various states. Grade crossings are sometimes included and sometimes not; corners of city streets always; highway intersections usually depend for their inclusion upon whether there is an unobstructed view on approaching them—which is a matter for the individual judgment of the driver; curves and heavy grades are sometimes included specifically and sometimes left to the driver's judgment; bridges enter the matter in some states; schools usually; and so on. The number of states in which it becomes necessary for the automobilist to distinguish between corporate and unincorporated towns is no less than ten.

Without any intent to criticize the enactments in question, or to deny that in many cases they may be necessary, a few eccentric items may be lifted from the speed laws of some of the states. Tennessee's requirement of an absolute stop at grade crossings heads the list. Rather drastic is Arizona's limit of four miles for dams, bridges, sharp curves, steep grades, etc. Colorado's geography makes it necessary for her to have four different figures for her mountain roads—20, 18, 15 and 12—which apply according to the character of the road; they are presumably posted, since so many cars from other states come to Colorado. Kansas calls for a speed of eight miles at railroad crossings and highway intersections in general, and six miles at such points in incorporated towns. When passing pedestrians or led animals on the roadway, the Mississippi driver has to slow to eight miles, and he has to distinguish between narrow causeways and wide ones, for the sake of a ten-mile limit on the former. New Jersey distinguishes between the car that runs *through* a road intersection at 15 miles per hour, and the one that turns the corner at 8; and you are supposed to restrain yourself to 15 in passing horses (but, presumably, not in overtaking horse-drawn vehicles, though the law does not make this exception). New Mexico has a similarly ambiguous provision about passing *all* other vehicles at 15 miles per hour. North Dakota has a rule imposing 7½ miles per hour on the man who drives out of a side street into a main one. Virginia restricts the man who is being overtaken to twenty, and the driver who passes a gathering of men or horses to ten. Wisconsin has a limit of twelve in public parks.

There is no point in multiplying examples. We have said enough to indicate plainly that in every point pertaining to the conduct of an automobile, the laws of the several states vary widely. Obviously this complicates

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greatly the problem of insuring that the visiting motorist knows the law. A few states, of which Connecticut is a conspicuous example, go a long way to meet the motorist in this regard. When you enter the Nutmeg state over any main highway, you meet a large signboard apprising you of the fact, and summarizing those of the state's traffic laws which you most need to know. It *tells* you, for instance, what to do about the standing trolley. Pennsylvania is another commonwealth in which the interests of the "foreign" motorist are taken care of, as well as may be, by signboards. There is but one lower speed limit in this state, fifteen miles per hour; and all points at which or areas through which it applies are plainly posted. Where the restricted zone is of any length, its end as well as its beginning is marked, so that one is in no doubt when to resume speed. But 21 of the 38 states, either explicitly or through the absence of any prohibition, permit local jurisdictions to set up speed limits and other traffic laws, without reference to the state code; and by no means is it the case that all these states require that the special rules be placarded.

Of course, if you go into a strange state and plead ignorance as excuse for violating its motor code, the magistrate can, and doubtless will, confront you with the fact that the traffic laws are published in pamphlet form, and have been available for your inspection and study. Strictly speaking, this is true; but after whiling away a train ride from New York to Boston in perusal of 38 of these little booklets, we are not strongly impressed with the probabilities of learning to drive legally from them. Space is lacking here to cite chapter and verse for this opinion, which will be made the text of a future article.

For the present, we make but one further point. With few exceptions, where local conditions are entirely eccentric and demand to be met with eccentric laws—as in the case of Colorado's mountain roads—the same regulations for the licensing, equipment and driving of cars would work all over the country. Such a uniform set of regulations would obviously be superior to the present barbarous divergence among the states. The only reason why we have divergence in place of uniformity lies in the fact that 48 different legislatures, in 48 different places, have been passing laws, each without reference to what the others are doing. Evidently this will lead to 48 ways of accomplishing the same result. The conflict is not deliberate, it has arisen automatically. It will take, however, extreme deliberation, plus cooperation raised to the *n*th power, to replace conflict with uniformity. Can it be done?

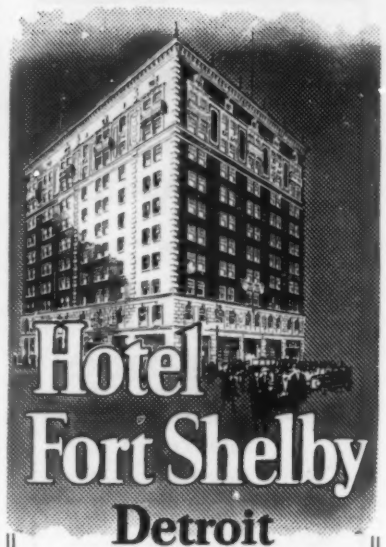
We believe it can. In future articles of this series, we shall survey the obstacles, suggest means for overcoming them, and try to make it clear why we believe that uniformity is possible, and why it is of vital importance that it be attained.

Cars of 1924

(*Continued from page 9*)

rough road, because it makes little or no difference whether he takes them in or not. Of equal importance to improving the degree of comfort is the effect on the mechanics and body of the car itself. So far no way has presented itself of making deliberate comparisons of the effect of low-pressure air in preserving the car from developing rattles, creaks and mechanical depreciation, but there is no question about its being a tremendous factor. This subject is of such interest that it is discussed at length in another portion of this issue. (Page 25).

There are many innovations in minor details that are interesting but space does not permit of a complete exposition. The Overland closed car is made with movable seat backs and cushions so the interior can be converted into a roomy sleeping compartment, making the car well adapted for touring and camping. Then again, many cars are now sold completely equipped with bumpers, luggage carriers, rear stop signals, windshield cleaners, shock absorbers, carburetor intake filter screens, thermostatic water circulation regulators, disc wheels, and numerous other devices that increase motoring comfort and that in past years had to be purchased separately and installed by the motorist. Summing up, in the writer's opinion, the purchaser has never before received such value for the money expended in a motor car purchase as is offered in most of the new models for the coming season. Bodies have been greatly improved in appearance and even those fitted to low-priced cars are graceful in outline and complete in appointments.



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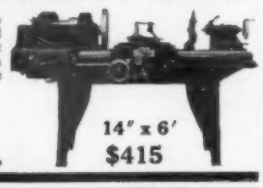

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Scientific American Digest

(*Continued from page 64*)

A new method of making patterns for large castings consists of building up a series of ribs with filling pieces fastened in between them, instead of building up elaborate patterns and core-boxes. The spaces between the skeleton ribs are filled with molding sand. This method has been particularly successful in cheapening cost.—*Am. Machinist*, 59 :15, pp. 553-55.

Rail steel reinforcing bars are sometimes referred to as being "re-rolled." This term applied to rail steel is a misnomer. In rolling rail steel bars, the rail is separated into three parts—the head, web and flange—and these parts are treated individually as billets and rolled into bars, or other sections. The rail steel bar is, therefore, the result of a continuation of the rolling process, and is in no sense a "re-rolled" product. The objection to the term "re-rolled" is that it permits confusion of rail steel bars with bars re-rolled from various kinds of scrap, shell discard, etc.

The effect of finishing scratches, such as are left by the different machining processes used in machine shops for finishing crank shafts and other parts of machines subjected to alternating stresses, have been studied out experimentally at the engineering laboratory of Oxford University, England. This modern practice, as employed in automobile engineering, is in itself an indication of the widely held view that surface finish has an appreciable effect upon the endurance of the metal. This varies quite widely according to the shape of the grooves made by the finishing tool. The results show that, provided the variation in depth is small, the increase of stress varies as the square root of the depth of the scratches divided by the radius of curvature of their point or inner extremity. The actual reduction of strength is, for the small scratches commonly met with, however, much less than is indicated by the mathematical theory.—*Engineering*, 116 :3015, pp. 449-52.

Railways

Cast steel freight car underframes.—While the use of large steel castings in locomotive and steel passenger car construction has become quite general, the use of cast steel in freight car construction has practically been limited to the smaller units such as the truck side frame, truck bolster, etc. For this reason the combination of center sills, body bolsters, etc., in a one-piece unit steel casting with ¾ and ⅞ inch sections as recently applied to a number of 80,000-pound capacity double-sheathed box cars on the Southern Pacific Lines represents quite an achievement. Underframes of this type have recently been applied to 10 new 80,000-pound capacity double-sheathed box cars constructed for the Southern Pacific Lines. The underframe is cast so as to form two center sills, each of a Z-section, 9 inches high, ¾ inch thick in the web and ⅞ inch thick through the flanges. These are approximately 30 feet long between the inside flanges of the body bolsters. Both the top and bottom flanges of these center sills are connected at intervals by cross members ⅞ inch in thickness, so that this section of the underframe is practically equivalent to a box girder section having an aggregate cross-sectional area of 24 square inches.—*Railway Rev.*, 73 :13, pp. 447-48.

Concrete ties of the Stent design, of which about 200,000 are in use on over a hundred miles of main track in India, are of the block type, each tie consisting of a pair of reinforced concrete blocks connected by a steel tie bar. For a gage of 5 feet 6 inches, 110-pound rails and 26 tons axle loads, the blocks are 25 x 16½ inches on the base and 6½ inches thick, reinforced by upper and lower sets of horizontal bars connected by stirrups. Four plugs of treated wood inserted in the block serve to hold either drive spikes or screw spikes. Each block weighs 166 pounds and the tie bar 16 pounds, the total weight of tie with all fittings being about 350 pounds. A concrete mix of 1:2:3½ is made with 2 parts hard silica quartzite and 3½ parts of ¼- to ¾-inch aggregate. Only sufficient water is used to make the concrete flow when the form is shaken on a vibrating table. After being left in the forms for twelve hours the ties are cured thirty days under water and then thirty days in air, but are usually at least three months old before being laid. Their life is estimated at 50 years. A few of the ties which have been in service for about nine years are said to be in as good condition as when laid.—*Eng. News-Record*, 91 :13, p. 511.

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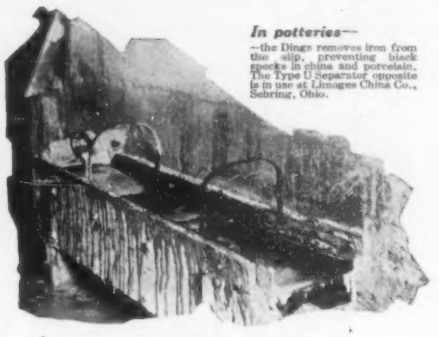

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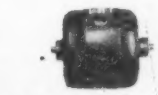

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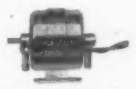

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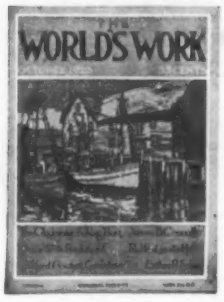

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The Economic Position of Motor Transport

(*Continued from page 12*)

rail terminals—all very big factors in these days of small operating profits and high real estate values.

Now, the principal advantage of the unit container adaptable to rail and road vehicles in the transportation of goods is the saving in labor costs by reduction in handling operations. To quote from the paper by F. S. Gallagher, engineer of rolling stock, New York Central Lines, we learn that: "The saving in labor and time may be seen by noting, in detail, the number of times that less-than-carload lots of freight must be handled from the shipper to the consignee. Let us follow one package from start to destination: First, it is carried from the packing-room to the warehouse platform; second, from the warehouse platform to the wagon, by hand truck; third, from the hand truck into the wagon. This is man-handling. The wagon then proceeds to the freight-house, where at the platform occurs the next man-handling. The fourth man-lift is from the wagon to the freight-house platform, and the fifth, from the platform to the hand truck. The individual package must be weighed, proper records made, and then taken into the car, making the sixth movement. A seventh handling is the stowing into the freight-car, after which is attached the seal, which is broken at destination. The eighth handling is made by the unloader lifting the freight to the floor of the car for the hand trucker; the ninth, the hand-trucker with the package stopping while record is being made of the shipment going off the car. The trucker then carries this freight to a designated place in the freight-house and it is left there. The consignee is notified that his goods have arrived, sends his wagon to the freight-house, and notifies the delivery clerk. The delivery clerk points out the shipment to the hand-trucker, who takes it to the wagon for loading, which is the tenth handling. When the package is delivered by the hand-trucker to the wagon platform it is dumped at the tail-gate of the wagon, making the eleventh handling, and must be handled the twelfth time to place it into the wagon. At the consignee's receiving platform the goods must be unloaded from the wagon, making the thirteenth time that this package has been handled." Coming from such a source, and with such a bill of particulars, we must accept this narrative of absurdity at its face value. Surely containers are needed!

Looking at the proposition strictly from a railroad standpoint, the unit container can be used to great advantage in such cases, as, for instance, where l. c. l. traffic loaded in a car at A is transferred into another car at B and into another at C, in which car the consignment eventually reaches its destination, D. With a unit container, the transfer at B and C could be accomplished by simply taking the container off one car and placing it on another. As it is done now, each piece of goods has to be handled four times by the railroad company—and, of course, by man-power.

Other advantages of the unit container are the savings from loss and damage to goods, and the saving that can be made on many classes of goods in crating and packing. This, in turn, permits of very material reduction in floor space required, which makes expansion of the business possible without further outlay in rental or property. The advantages of the demountable body or flat over the conventional fixed-on types are principally savings in time, and savings in floor and street space. For instance, the motor truck chassis' standing time can be reduced to a minimum by the scientific use of demountable equipment. The best demonstration of this can be seen at Cincinnati, where they use 225 bodies with only 15 motor truck chassis. The voluntary standing line of these trucks for fifteen trips in eight hours is only about fifteen per cent of the total, an excellent showing for the demountable truck-body.

Referring to bodies and flats, it is thought that motor truck owners have failed to realize the possibilities of this kind of equipment, largely because they usually conclude that overhead cranes or tackle of some kind are necessary at loading platforms, in order to make the operation really effective. They have, therefore, evidently lost sight of the fact that with properly designed equipment wherever platform and chassis levels are about the same, no overhead cranes or special equipment are required, and, furthermore, that the bed or flat can remain on the chassis for any length of time desired, but is adapt-

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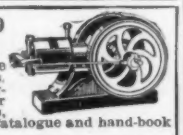

Type Q. Stationary—1 in. bore x 1 1-8 in. stroke. Weight 8 lbs. 6 oz. Price complete, $17.00, forwarded prepaid. Many other types model Engines, Boilers, Boiler and Ships' fittings. Catalogue and hand-book 20c (refunded on first order).

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able for removal where conditions permit. And now that we have found a way to transfer a flat or body from the ground to either truck chassis or flat car on rails, with the power derived from the motor truck engine, another disadvantage has been overcome.

But, going back to the unit container used for interchange between electric and steam railways, and road vehicles, we have another story, and a problem requiring for its solution the closest cooperation of all transport agencies and all traders or merchants. Where a balanced bulk-load traffic in both directions can be had, unit container equipment holds out great possibilities for saving time and labor and thus a more economical movement than is possible by conventional methods. For instance, under a properly coordinated plant, a merchant with stores in several cities might use unit containers to great advantage. But unless the containers can be loaded in both directions, the ultimate net saving will be very little and the venture may even turn out to be unprofitable, because the cost of transporting the empty is strictly waste effort. A container of light construction such as the duralumin one referred to is therefore highly desirable from this as well as other standpoints.

Our Abrams Investigation—IV

(*Continued from page 17*)

which are inherently faulty, so that their outcome will be of absolutely no value. Hence when the difficulties of preparing blood specimens were outlined to us by Dr. Abrams' personal representative, we offered to make every necessary allowance for detrimental effects. We agreed to have an E. R. A. man take the blood specimens himself, although we fully realized that such procedure somewhat weakened our test conditions.

The object of such a test is to compare the electronic diagnosis with the known facts regarding the case. Just as various E. R. A. men tell us that they check up their electronic diagnosis time and again with clinical findings in order to have a confirmation of their findings, so we intended to report the E. R. A. diagnosis and the clinical diagnosis side by side. Such a test would be interesting in many ways. If we are to believe the E. R. A. teachings at this time, it would be as much of a test of the accuracy of the orthodox clinical findings as of the E. R. A.

Under date of October 30th, Dr. Abrams replies to our request for blood diagnosis tests as follows:

"Your suggestions to submit to blood tests as a conclusive procedure is fraught with many errors.

"Notably, in the matter of reconciling the average clinical diagnosis with the electronic reactions. The latter are essentially etiological diagnoses or diagnoses based on the causation of disease.

"The average clinical diagnoses are based on the existence of a supposed lesion which is expected to be found at the autopsy. The electronic reactions are diagnoses of processes, while the average clinical diagnoses are based on structural changes. For this reason they cannot be expected to agree.

"It is conceded that the average errors in clinical diagnoses under systems other than that of E. R. A. vary from 50 to 90 per cent. It is a quite different matter whether examinations are made voluntarily or subject to test conditions. The psychological factor is an enormous one, as shown in my journal. . . . .

"I shall, on coming to New York, submit to demonstrations that shall be just and scientific and before bodies who may seek such demonstrations for the sake of science and humanity, so that I may prove the efficiency of the E. R. A."

The abstracts from Dr. Abrams' letter explain themselves. We gather (1) that the electronic and the clinical diagnoses are two entirely different things and therefore cannot be used together for comparison; (2) that Dr. Abrams does not care to undertake blood tests at this time because (3) such blood tests are opened to many errors, (4) that Dr. Abrams will submit to "demonstrations" here in New York before a scientific body. In all our correspondence with Dr. Abrams it is evident that he differentiates quite clearly between "demonstration" and "test," and that his cooperation is to take the form of "demonstrations" and not "tests." Dr. Abrams, it will be noted, calls attention to the psychological factor. He indicates that when the E. R. A. diagnostician is working under test conditions, he is at a decided disadvantage because of his anxiety regarding the outcome of the test. From time to time we have been warned against a skeptical turn of mind, for such a state of

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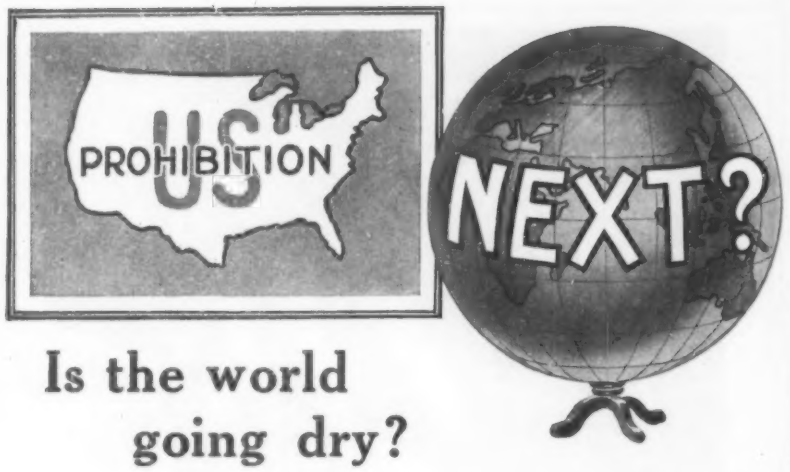

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TO THE MEDICAL PROFESSION

The SCIENTIFIC AMERICAN invites your interest and cooperation in its investigation of the ELECTRONIC REACTIONS OF ABRAMS. We fully recognize the vast public interest in this highly controversial subject and we enter the investigation open-minded, unprejudiced and at the same time unwilling to either endorse or expose without first-hand proofs.

The SCIENTIFIC AMERICAN will investigate on a thorough, scientific basis, listen to the arguments and claims of both sides; and conduct a series of tests under the Abrams methods, with a critical examination of the apparatus. Dr. Abrams has placed at our disposal his services and his laboratories, and eminent members of all branches of the medical profession will assist in this sincere effort to give the public the truth on this subject.

We shall be glad to have the benefit of your experiences and opinions. This investigation was inaugurated in the October, 1923, issue, and its progress is being reported in each issue until its conclusion. Should you wish to follow this investigation from the beginning we will be glad to enter your subscription for 1924, and mail you the October announcement with our compliments.

SCIENTIFIC AMERICAN

mind on the part of the investigator has a decidedly detrimental influence on the reactions and consequently on the accuracy of the findings. However, we are certain that test conditions can be formulated in such a manner as to approach closely those of the usual informal diagnosis. The E. R. A. diagnostician may take our specimens into his own laboratory and there, removed from any unfavorable influences, work out his diagnosis in the manner in which he is most accustomed. E. R. A. men have been reassured on this point time and again.

We sincerely hope that Dr. Abrams will see his way clear to undertake a series of tests for us. He is the foremost electronic diagnostician. He is the discoverer and the dean of the electronic practitioners. His name is known to the public and carries conviction, so far as any test is concerned.

Recently we had the visit of Dr. Jean du Plessis, M.D., who has been quite close to Dr. Abrams in the development of the electronic technique, who is considered to be one of the foremost electronic diagnosticians today, and who has done a great deal of research work of his own. Dr. du Plessis met several members of our committee and participated in an exchange of views regarding the claims made for electronic technique, as well as our past and present experiences with E. R. A., and our plans for the future. Dr. du Plessis urged that we arrange for tests with Dr. Abrams, rather than continue to make tests with E. R. A. men in the field. To this end, Dr. du Plessis is exerting his good offices in an endeavor to have Dr. Abrams submit to tests by us without further loss of valuable time.

To those who have any doubts regarding the sincerity and seriousness of our Abrams investigation, we gladly refer them to Dr. du Plessis of Chicago. Dr. du Plessis found us fair and open-minded, anxious to learn all we could regarding the electronic reactions, ready to make allowances for the delicate forces involved, and willing to accept proofs far less significant than the fantastic claims made for everyday E. R. A. work. On our part, we found Dr. du Plessis sincere, modest in his appraisal of E. R. A., sympathetic with our views, well-versed in E. R. A. and capable of explaining its intricacies in a clear, positive, and understandable manner.

Thanks to the kind offices of Dr. du Plessis, the leading electronic societies are now cooperating with us for the purpose of formulating a definite set of claims which they are going to submit to our test. Questionnaires are being sent to members of these societies, so that the E. R. A. claims can be boiled down to their very essentials, filtered so as to remove the nonsensical features which have caused so much misunderstanding and harm to the cause, and presented to us in order that we may have something to work on. Research committees are being formed by these societies for the purpose of undertaking our tests. It is hoped that Dr. Abrams himself will head the research committees.

Several weeks ago, at this writing, we attended another demonstration of the electronic diagnosis. In this instance we were shown the touch method of diagnosis, which consists of running the tips of the fingers over the reagent's skin and detecting a roughness which is said to represent the electronic reactions. We were taught how to proceed with a diagnosis of a blood specimen.

Frankly, we were enthused with the prospects of giving the reactions such a direct and, we hoped, convincing test. The method of detection in this case seemed to offer more definite indication of the reactions than the usual percussing method or the sticking of a glass rod. Nevertheless, after trying for the better part of an afternoon to detect the reactions through the roughness of certain areas of the reagent, we are free to confess that we failed. If the reactions really gave rise to roughness, as claimed, they could not be demonstrated, even by a stretch of imagination, to our mildest satisfaction. We were keenly disappointed.

In an early issue we shall make a formal report of what we saw at the Burnett-Timken Research Laboratory at Alpine, N. J., where an extensive study of the electronic reactions has been under way for some time. Rather extravagant use has been made of the Burnett-Timken findings regarding the E. R. A. equipment, by electronic practitioners, and it was in order to weigh the importance of these findings that we spent an entire day with Dr. Burnett and his research chief, Mr. Hallberg.

All of which is by way of stating once more that the electronic reactions, on which electronic technique is built, have not been demonstrated to us in a convincing manner,

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The Future of the Air-Cooled Car

(Continued from page 23)

or ignition timing or poor mixture adjustment that would seriously interfere with proper and efficient cooling by air. This cannot be considered seriously as an objection, however, because no engine is supposed to operate under conditions of insufficient oiling or incomplete carburetion, and any engine which would give an early warning of either of these unfavorable factors should be preferable to one that would continue to operate inefficiently and perhaps to the detriment of its mechanism. As far as uniform cooling is concerned, a blower-cooled engine will function as well as any water-cooled power plant under the same conditions of speed, road or gradient.

There can be no more question regarding the suitability of air-cooled engines for certain classes of aircraft than there is about their successful application in automobiles and motorcycles. The writer had personal experience during the late war with many hundred air-cooled engines of both the rotary and fixed-crank types that were operated under his personal supervision in exacting training work; and absolutely no trouble was experienced in cooling them even though they were run under full load and speed conditions most of the time. S. D. Heron, of the Society of Automotive Engineers, a well known authority on air-cooling, reports the satisfactory cooling of an eight-inch bore by ten-inch stroke cylinder by direct air cooling and the development in a smaller air-cooled cylinder of 138 pounds per square inch brake mean effective pressure, which is decidedly more than that developed by any standard automobile engine. A 60-horsepower three-cylinder radial air-cooled engine having aluminum cylinders with liners as previously described was given a break-down or endurance test and stood up beyond any reasonable expectations for water-cooled aviation engines, even though it showed a brake mean effective pressure of 125 pounds per square inch, which compares very well to the 90 to 110 pounds found in average automobile engines.

Direct air-cooled engines have been operated from the Atlantic to the Pacific, far north and far south, through Death Valley and across the American desert, in torrid heat and arctic cold; and the splendid performance of the new types has demonstrated beyond doubt that air-cooling is desirable and practical and, in my opinion, on the eve of greater application in automobiles.

Floating the Car on Oil

(Continued from page 24)

it is most needed. Incidentally, roaring the motor does not accomplish the desired purpose as well as a moderate speed with a retarded spark.

On cold winter mornings a motor that has been standing all night in an unheated garage may often be started by pouring warm water from a tea kettle on the intake manifold, or still better, on a rag wrapped around the carburetor. The added heat makes a decided difference in the amount of gasoline that will be vaporized, even if the parts are not heated very warm to the touch.

Running in weather that is very much below the freezing temperature cools the engine too much, not only for most efficient operation, but for the complete consumption of the fuel, unless the radiator hood is used. It should be remembered that an internal combustion motor operates at its best efficiency at temperatures as high as the boiling temperature of water and one reason a radiator is not made small enough to keep the water near the boiling heat is that the water would have to be replenished too often for convenience. When the engine is too cool the fuel is poorly or partially vaporized and much of it finds its way past the rings to dilute the crankcase supply.

Another trouble that follows in the train of incomplete vaporization of fuel in cold weather is an accumulation of water in the crankcase, due to that fact that when a mixture of gasoline vapor and water is fired, water is one of the by-products. This water, before the engine is heated up, gets into the crankcase where it may freeze in a layer beneath the level of the oil which floats on it, and break the oil-pump, or make it inoperative. Incidentally, it may make an

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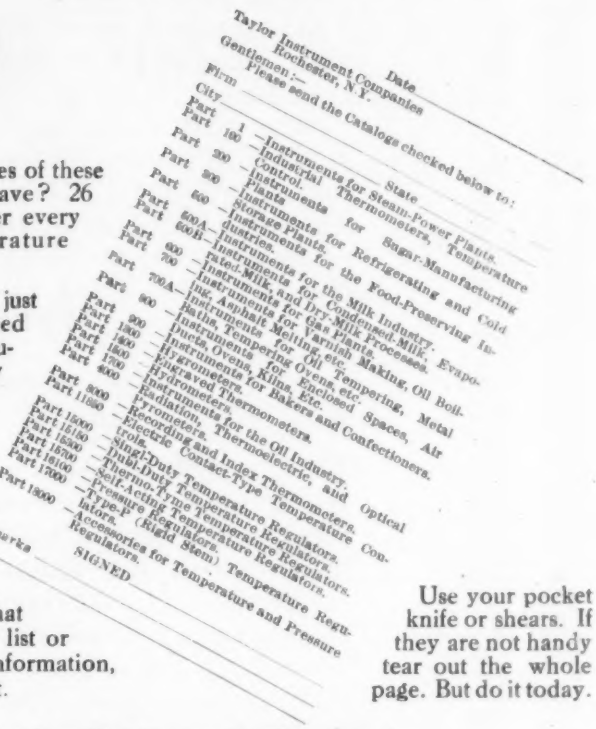
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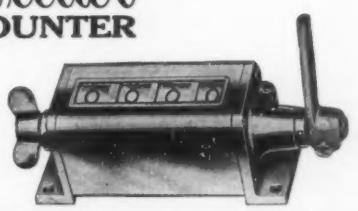

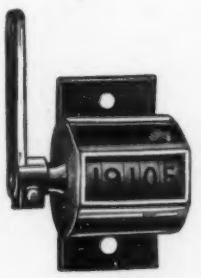

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emulsion with the oil and result in scored cylinder walls. Probably the safest and easiest way to get around this possibility is to drain the crankcase every 400 or 500 miles in winter.

One very important thing is to drain the crankcase only after a run, when the motor and the oil are thoroughly heated up. This is not merely for the purpose of getting rid of all of the oil by losing it when it is at a free-running heat, but for the much more important reason that all the fine particles of metal which have been worn from bearings, as well as the sand that has clung to the cylinder-bloc casting and worked loose will then pass out with the oil, instead of settling and remaining each time to provide an accumulation of excellent abrasive where the opposite effect is sought.

Many bearings have been burned out in almost a moment by starting an engine in cold weather when the oil is very viscous and will not flow to the bearings in time to lubricate them. It takes only a small change in temperature to double the time necessary for a given oil to flow through a small passage and for this reason the motor should be dealt with very gently for a few moments.

At such times the differential, and the transmission gears also, will merely break a channel in a sump of oil which has become practically solid, and since gears seldom develop heat enough to melt down the walls of oil thus created in time there is nothing to save them severe damage. In cold weather, therefore, it is advisable to mix one part of motor oil with two of gear oil, in order to bring the gear oil to the right degree of viscosity. For the chassis, winter lubrication calls for a lighter cup grease for grease cups and the same grade of oil used in the motor for the oil cups. At this time it will be necessary to keep better watch of the various oiling places on the chassis, since the cold weather may render them ineffective at any time.

With the Men Who Fly—III.

(*Continued from page 27*)

along the line of the wind. In the most recent designs, hydrogen mains, fuel pumps and water pumps are incorporated in the structure, together with elevators for passengers and baggage.

Of course, the entire design of an airship is an effort to secure safety, and refinements and improvements are constantly being introduced. Skilled handling is required, and in time crews will become as skilled in handling a gigantic dirigible as the officers and crew of ocean liners are in handling the "Leviathan." In the history of engineering in general and transportation in particular, no early disasters have prevented the final introduction of any invention which had an economic service to render.

And in favor of the airship there are distinct economic factors. Given a steamship and an airship of equal gross weight and equal speed, the airship will require only one-tenth the horsepower of the former. Here is the basic reason why more speed can be obtained. The surplus power of the dirigible can be used not to economize on fuel but to increase speed. This is the airship's real reason for existence. A speed of 60 m.p.h. is practically impossible for a steamer, but is an easy matter to attain for a dirigible; 83 miles an hour has been reached and 100 miles an hour is simply a matter of design. Captain Anton Heinen, German consultant in the construction of the "ZR-1," estimates, for example, that the time of a voyage from San Francisco to New Zealand could be cut from 22 days to 6 days.

The not inconsiderable carrying capacity of the dirigible, added to this tremendous saving of time, will ultimately give it a place in ocean travel on a vast scale. But the initial expenditure in the purchase of equipment and in base organization is enormous. In running charges, fuel itself would be an inconsiderable item, but repairs, replacements, the use of expensive helium gas, the costly process of learning how to run a dirigible line, and the possibility of a low volume of traffic at the start, do not make it probable that operations would be immediately successful from a financial point of view. The formation of an airship line, while entirely feasible and promising, must be undertaken with gigantic capital, with men of enormous financial strength who can take a long view of matters and not be discouraged by the loss of money in the first two or three years of operation.

Airships or Airplanes?

Controversy often arises over the question as to whether dirigibles or airplanes will ultimately be the vehicle of air transportation. The answer is that the two have entirely different spheres of action, and that one type of aircraft cannot trespass on the work of the other from the very character of the basic principles in the construction of each type. The airplane spells speed without practical limit, but has a very definite limitation in size, range and carrying capacity. The dirigible can never hope to attain anything like maximum airplane speeds, but there is no practical limit to its size or carrying capacity, and the larger it is the more economical it becomes.

This admits of a ready explanation. If a small airplane is taken and duplicated on geometrically similar lines but a much larger scale, its total lift will increase as the square of the dimensions, while its structural weight will increase theoretically as the cube of the dimensions. Hence, as the airplane increases in size, its structure will bear a larger ratio to the total weight, although this effect can be minimized by improved construction in large size airplanes, and its useful carrying capacity will diminish as a percentage of the whole. There is, therefore, quite a definite limit to the useful size and range of an airplane. At the same time the difficulties in landing a huge machine increase very considerably.

With the airship the situation is different. Its volume of gas and hence its lifting capacity increases as the cube of the dimensions. Its structural weight remains the same or becomes even a diminishing percentage of the whole weight, while the power required depends mainly on the surface area and therefore on the square of the dimensions. A large dirigible, therefore, requires less fuel than a smaller one for the same speed, and while the percentage of available load may not increase, the percentage of commercial pay load increases indefinitely with size.

Economically speaking, therefore, the right direction is toward comparatively small airplanes and enormously large dirigibles.

But when it comes to speed, the dirigible, while it compares more than favorably with ships, or trains, must of necessity lag far behind the airplane. This is due to a remarkable and often unrecognized principle of the airplane. No matter what the speed of an airplane is, the pull required to propel it through the air remains the same fraction of its total weight. So that to carry an airplane over a given distance the fuel used will be substantially the same whether it is flying fast or slow. We may travel very fast in a plane between two points and use up fuel very fast, or slowly and use fuel more slowly. But the total quantity of fuel used between the two points will be the same. Hence it is economically possible to drive the airplane at any speed we desire, subject to such limitations as landing speed and the physical endurance of the pilot.

In the dirigible, however, the same law of resistance applies as in the propulsion of ships. Namely, the pull increases as the square of the velocity, and the horsepower as the cube. Just as it is impossible to drive the "Leviathan" through the water at 60 miles an hour without the use of such gigantic engines that no cargo or passenger capacity is left, so with the dirigible it is impossible to go beyond a certain speed without destroying all commercial possibilities.

No matter what temporary departures from basic principles there may be in the use of the two types of aircraft, ultimately fundamental laws will win out. The airplane will be supreme for comparatively short hauls of between 500 and 1200 miles; it will be comparatively small and will carry business men in a hurry, mail and express matter of small bulk. The airship will be used for long hauls between 1200 and 5000 miles or more, it will have an enormously greater carrying capacity and will ultimately carry real freight in addition to mail and passengers. It will be supreme for transoceanic services and possibly for transcontinental work, although here it may meet with strenuous airplane competition. Or a combination system may come into being where airplanes will act as feeders to the main dirigible lines.

Hazardous as it is to make any prophecies in the matter, we can safely say that no type will supersede the other; that one will be used in conjunction with the other.

But enough has been said in this series of articles to show that the commercial possibilities of both airships and airplanes are enormous, that they are even now ready for application on a vast scale, and that we are on the eve of a revolution in the technique of air transportation both over land and sea.